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Abitibi Bond Interest Exempt From Tax

New Ruling Clarifies One Phase of Abitibi Tax Situation But Immediate Payment Is Deferred Pending Decision of Foreign Exchange Control Board On Exact Status of U. S. Boldholders.

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., July 21, 1941—It is understood in financial circles that the coming payments of interest on bonds of the Abitibi Power and Paper Company, Ltd., will be exempt from income tax. The Dominion Income Tax Branch has ruled that the interest payments recently authorized are not subject to the levy, it is said.

Another Preventative Feature

There is another feature, however, that still prevents the immediate payment as has been expected for some time. It is not yet clear whether the Foreign Exchange Control Board will allow bondholders in the United States or other non-residents exchange for their cheques. The point has not yet been definitely settled, but the bondholders' protective committee is satisfied that United States dollars can be purchased in the usual way.

It could probably be done by issuing special cheques to American holders of the bonds, with a notation that the Canadian funds could be converted at official exchange rates.

Payment Held Up Pending Decision

The point at issue here is to decide whether or not the Federal Exchange Control Board will regard this payment as an export of capital, something which the board does not permit at this time. The alternative is to regard the payment as in effect the payment of a bond at maturity to foreign holders, a thing which has so far been permitted by the board.

Have Been Holding Up Payments

These two points have been holding up actual payment of the cash ever since it was authorized by the Ontario courts several weeks ago. In the meantime, certain technical details have been cleared up, or will be very soon. Just when the Exchange Board will get around to making final disposition of the question is problematical. An order of the Master of the Supreme Court of Ontario will likely be required to fix the final date of payment.

It is pointed out that this is only an interim payment, anyway. The exact amount of the deduction from the principal of the bonds will only be settled when the final payment is made and the question of payment of U. S. funds is settled. The fact that this payment is being made in Canadian funds is not taken to mean that bondholders are surrendering their claims to payment in U. S. funds.

Urges Saving of Waste Paper

WASHINGTON, D. C., July 23, 1941—Hope that waste paper supplies in communities throughout the country will be increased by avoiding thoughtless destruction was expressed by Leon Henderson, Administrator, Office of Price Administration and Civilian Supply.

In a letter to one of the sponsors of a drive for increased supplies in the St. Louis area, Mr. Henderson cited estimates that more than two-thirds of the huge quantities of newspapers, magazines, paper boxes and wrappings that find their way into American homes are destroyed.

Mr. Henderson pointed out that additional supplies of waste paper, cardboard, etc., are required for conversion into containers used to package and ship the thousands of articles being produced by defense industries.

"On behalf of the Government," Mr. Henderson said, "I urge that waste paper be saved by the householder for collection by waste paper dealers."

Waste paper supplements importantly the nation's available supplies of wood pulp. Evidence of a growing shortage of this essential raw material emphasizes the need to save waste paper in all its forms.

Masonite Corp. Builds Hospital

The Masonite Corporation, Laurel, Miss., has completed construction of a modern hospital in the main city district to house its clinic for employees at the mill and their dependents. The building and equipment represents a cost of about $60,000. With its location in city proper, the new structure also will serve as an additional medical center for citizens of Laurel.

Priorities Affecting Wisconsin Plants

Voluntary Reduction Up To 24 Per Cent In Use of Chlorine May Increase Production of Tinted Papers — Sulphite Liquor By-Product In Demand — Power Expansion Proposed — Other News.

[FROM OUR REGULAR CORRESPONDENT]

APPLETON, Wis., July 21, 1941—Wisconsin's increasing paper production is posing problems that relate to the displacements of routine manufacture because of defense priorities.

One of these is the solution of bleaching problems because of the curtailment of the chlorine supply. Voluntary reductions of as much as 24% in chlorine use have been made by mills in response to appeals from the Office of Production Management. While other effective methods of bleaching may be developed, the public probably will have to be content with papers of a lesser whiteness. One suggested solution has been to urge the purchase of tinted papers as a gesture to aid the defense program.

Sulphite By-Product in Demand

The Salvo Chemical Corporation division of the Marathon Paper Mills Company, Rothschild, Wis., is unable to supply the present demand for vanillin, although its production has been stepped up 50%. The product is one of the big items of salvage from sulphite liquor under the Howard process controlled by the company. Tanning extracts also are undergoing greatly increased demand.

Shortage of Waste Paper Felt

A possible shortage of waste paper is envisioned by J. S. Clemons, plant manager of the Hummel and Downing Company, paper board and box manufacturers of Milwaukee, Wis. The company a year ago was buying 190 tons a day, but its present carton demand has stepped the deliveries up to 260 tons per day. An inventory of 3,500 tons is maintained.

A public appeal was made through the newspapers recently by Dr. Clemons urging the people to save their waste paper, pointing out such cooperation as a patriotic duty. "All board mills are operating at capacity," he said, "and while there is no shortage of waste paper yet, chances are there will be." He revealed that the company produced 500 tons of practice targets for the army, the last of which were shipped at the end of June. The targets filled 20 freight cars.

Power Expansion Programs Proposed

Looking to the increased demand for power, several expansion programs are proposed in Wisconsin to take care of the growing load of integrated plants serving the paper mill areas and other regions.

The Wisconsin Michigan Power Company, Appleton, Wis., is awaiting authority from the Federal Power Commission to start construction of a 15,000-kilowatt capacity power plant near Florence, Wis., in the Michigamme River basin at Peavy Falls, just over the Wisconsin border, according to W. E. Schubert, general manager. It will be located near the storage reservoir dam recently completed by the company on the Upper Michigamme. Plans and specifications for the plant are complete.

Additional to its present construction of a 30,000-kilowatt addition at its plant at Green Bay, Wis., the Wisconsin Public Service Corporation plans to add another unit of 50,000-kilowatts in 1945, according to J. P. Pulliam, president. The present expansion, to be completed in 1942, will boost the current capacity by 150 per cent.

The Wisconsin Electric Power Company of Milwaukee, Wis., with which the Wisconsin Michigan Power Company is affiliated, contemplates vast additions. Two of these roughly estimated to cost $5,000,000 each are to be made at the Commerce St. plant in Milwaukee, one of 50,000 kilowatts to be completed in 1944 and another of 50,000 kilowatts in 1946. The Allis-Chalmers Company of Milwaukee, is delivering a 35,000-kilowatt turbine to the Commerce St. plant at the present time for a $4,137,000 project. The new unit is expected to go into service in October, raising the capacity of the plant to 65,000 to 75,000 kilowatts.

Another 80,000-kilowatt unit is being constructed for the Wisconsin Electric Power Company's plant at Port Washington, Wis., at a cost of $7,500,000. The plant is laid out so a total of four or five of the 80,000-kilowatt units can be built. The program calls for completion of one in 1944 and another in 1946, at approximately $7,500,000 each.

Some difficulty is being experienced with power supply because of the low water stages in the Wisconsin and Fox Rivers, due to the lack of normal rainfall in June. Reservoirs are low, and it has been necessary to resort to steam or commercial power. The Marathon Paper Mills Company at Rothschild, Wis., reports that the low flow of the Wisconsin River has caused a shortage of 1,000 kilowatt hours.

Paper Mill Employees Hold Outings

Employees of the Kimberly-Clark Corporation are making the most of the summer season with picnics and other events. The Kimberly Mill Workers Union of the mill at Kimberly, Wis., will hold its annual outing Sunday, July 27, at Kimberly Park. The program will include games and contests, a band concert and dancing at the mill clubhouse. Refreshments will be served free to the children at the stands. The mill will be closed down for the event.

Laboratory and testing station workers of the Kimberly mill held a picnic at Telulah Park at Appleton Thursday, July 17, featuring a softball game and supper.

More than 100 golfers gathered at Ridgeway Golf Club at Neenah, Wis., Saturday, July 19, for the annual Kimberly-Clark golf jamboree. Qualifying rounds were played for the annual tournament, and a dinner was held in the evening at which many prizes were distributed.

Employees of the Central Paper Company, Menasha, Wis., held their annual outing Saturday, July 19, at Stroebe's Island, near Appleton, Wis. Softball and various games and races were enjoyed. The picnic lasted all day, with Julian Scheffler as general chairman.

Canadian Mill To Construct New Acid Plant

E. B. Eddy Co., of Hull, Que., Will Build At Once New Acid Plant Using Canadian Pyrites Instead of Imported Sulphur — Sweden Increasing Use of Paper In the Manufacture of Substitutes.

[FROM OUR REGULAR CORRESPONDENT]

MONTREAL, Que., July 21, 1941—The E. B. Eddy Company, Limited, whose large paper-making mills are situated at Hull, Que., has announced that construction will start immediately on a new acid plant in which Canadian pyrites will be used instead of imported sulphur in the manufacture of chemical pulp. W. S. Kidd, general manager, said the new departure would result in conservation of United States exchange to the extent of approximately $100,000 a year. It is expected that the plant will be in operation early next year.

Novel Uses for Wood, Pulp and Paper

Advices received here from Sweden state that in an industrial fair held in Stockholm many novelties manufactured from pulp and paper were displayed. The slogan of the fair was "How we are managing," and the object was to demonstrate what is being done on the part of Swedish industry to overcome as far as is possible the many difficulties caused by the war and the sea blockade. Included in the display were many new pulp and paper adaptations, and devices for their use. Here is an official account of this portion of the fair:

More Uses for Wood Increasing

"The most important Swedish substitutes are, as could be expected, being derived from wood. Producer-gas generated from charcoal or wood, has become the most common substitute for gasoline and heavy oils, and at this fair could be studied various kinds of producer-gas sets for automobiles, motorcycles, tractors, motorboats as well as for stationary motors. Wood and peat have also largely had to replace coal and coke, of which sufficient quantities cannot be imported. New improved types of boilers and furnaces for these fuels have in consequence been developed, of which several were on show. The heating problem has also prompted greater interest in insulation in various forms. Various kinds of board and paper have found a widespread use for this purpose. The latest novelty is a product called 'Wellit', consisting of several layers of corrugated board. The product, which has been developed by one of the well-known constructors of the Elektrolux refrigerator, Carl Munthers, is manufactured and impregnated in a special way, which makes it entirely impermeable by moisture. The product has an insulating capacity which is stated to compare favourably with cork, but it is considerably lighter and cheaper.

Utility of Paper Bags Expanding

"Still further products originating in Sweden's vast forests were exhibited such as textiles made of cellwool or artificial silk, products which will probably, however, like many others, maintain their importance also in peace time. The versatile use of paper bags was also illustrated—a product which owing to rationing of emballage fabric has become of increased importance. A new field where paper bags have found a specially widespread use is as containers for charcoal or wood fuel for producer-gas automobiles. Further, propaganda was being made for the use of serviettes and tablecloth as well as handkerchiefs and even ambulance material and babies napkins of paper, whereby textiles and washing soap can be saved. Two other products exhibited, emanating from wood, were a plastic paint and a kind of glue, both made from waste products from sulphite mills. Several important substitute products, as, for instance, cellulose cattle feed, soap made from by-products obtained at the sulphate manufacture, motor tar, etc., were, however, not on show, the above enumeration thus being far from complete."

Opposition to Priority Discussed

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., July 14, 1941—Why the Ontario Paper Company opposes efforts to apply prorationing of newsprint production to its operations is set forth in an elaborately printed and illustrated booklet just issued by the company. "No Newsprint For Sale" is the title of the booklet, which outlines the company's contention that prorationing should not be extended to Ontario Paper and its subsidiary, the Quebec North Shore Paper Company, because they are non-commercial manufacturers.

The brochure discusses the history of Ontario Paper's operations and conditions in the newsprint industry in general. It emphasizes that all of the output of the company's mills is used by the Chicago Tribune, which owns Ontario Paper, and the New York Daily News.

Heavy Demand for Wheat Straw

INDIANAPOLIS, Ind., July 21, 1941—The heavy demand of Hoosier strawboard factories for wheat straw this year, combined with the fact that several that have been idle for years have reopened, has changed the type of threshing on the part of Indiana farmers. At least half the wheat crop this year is being threshed instead of being combined in the field. Farmers want wheat straw and threshing the old way provides the only kind of clean straw the strawboard factories will buy. The amount of straw available this year in Indiana will be the largest in several years.

J. L. Ritchie in Charge at Washington

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., July 23, 1941—James L. Ritchie, assistant secretary of the American Paper and Pulp Association has been put in charge of the Washington office of the association located in the Raleigh Hotel.

Mr. Ritchie is acting as a sort of liaison man between the association and OPM and other governmental departments and bureaus. It is reported that the association may change its office location later.

Superintendents Hold Summer Frolic

KALAMAZOO, Mich., July 16, 1941—The annual summer frolic of the Michigan Division of the American Pulp and Paper Mill Superintendents' Association was held on the afternoon and evening of July 15, 1941, at the Gull Lake Country Club. Members and guests totaling 135 were present, the activities starting at 2 P.M. with the Golf Tournament in which 68 participated.

The "phoney" money bets among the players afforded much fun and each year a spirited contest is in evidence to accumulate the biggest bank roll for which three cash prizes reward the lucky ones.

Southern Dinner Served

Following the tournament, an excellent Southern dinner was served, with fried chicken and green corn the outstanding items. Later, all gathered in the ball room where the golf prizes were awarded as follows: Henry Reeves—1st Low Net; John Russel, 2nd Low Net; Harold Sinclair, 1st Blind Bogey; Paul Schreiber—2nd Blind Bogey; Al Perlick—3rd Blind Bogey; Henry Kennedy, Low Putt.

Cash awards for biggest accumulated bank rolls were—1st Prize, Marvin Jones; 2nd Prize, W. D. Sanders; 3rd Prize, J. W. Garside.

Roy W. Holden was General Chairman, assisted by Walter B. Hadley, and Al Sherwood.

Those in Attendance

Among those present were: Kenneth Adams, Kalamazoo Vegetable Parchment Company; W. H. Astle, Michigan Paper Company; Percy Abbott, Watervliet Paper Company; Walter Ayles, Amer. Cyanamid Corporation; Richard Alden, Watervliet Paper Company; J. M. Alden, International Printing Ink; W. P. Burleigh, Bird Machine Company; H. L. Berger, Sutherland Paper Company; Ray Barton, Michigan Paper Company; Robert Buss, Hercules Powder Company; C. L. Bachelder, Hercules Powder Company; Ed Barnes, Michigan Carton Company; Barney Benson, Williams Gray Company; Olin Blessing, Dow Chemical Company; Harold Buttery, Sutherland Paper Co.; Dallas Bachelder, Sutherland Paper Company; Harry Bradford, Rex Paper Co.; Wm. Costello, Jos. E. Loughead Co.; Primo Chitti, Otsego Falls Paper Company; E. T. Coughlin, Bryant Paper Company; Fred Chappell, Sutherland Paper Company, S. V. Cottrell, National Analine and Chemical Company; Norman Cowie, Hawthorne Paper Co.,..O. W. Callighan, Edgar Brothers Company; Art Coffin, Titanium Pigment Corporation; A. W. Cole, Rex Paper Company; G. V. Cathey, Goodrich Rubber Company.

Clifford Darling, Michigan Carton Company; J. D. Dickson, R. T. Vanderbilt Corporation; Paul de Guehry, Michigan Paper Company; Joseph Dennany, Allied Mills; F. B. Eilers, Orr Felts and Blanket Company; Herbert Farem, Watervliet Paper Company, H. D. Frost, Sinclair Company; Leo Fitzgerald, Hercules Powder Company; James Foxgrover, Hercules Powder Company; M. S. Fogerty, Michigan Paper Company; E. H. "Dad" Gilman, Watervliet, Michigan; F. B. Grunwald, Consolidated Paper Company; A. D. Gilchrist, Bond Supply Company; Glen Graham, Sutherland Paper Company; Andy Gilman, Sutherland Paper Company; J. W. Garside, Woodruff Coal Company; John Gilkey, Bryant Paper Company; R. M. Heistand, Sutherland Paper Company; Hod Heath, Rex Paper Company; V. Heinmueller, American Cyanamid Corporation; R. W. Holden, Stowe Woodard Company; W. B. Hadley, Sutherland Paper Company; Allen Hyer, Black Clawson Company; Dave Howard, Howard Smith Paper Company; H. F. Heller, Hercules Powder Company; Marvin Jones, Michigan Carton Company; A. H. Jubb, Sutherland Paper Company; Al. Johnson, Noble and Wood Company; H. B. Johnston, Allied Paper Mills; F. E. Kimmell, Sutherland Paper Company; W. Kennedy, Allied Paper Mills; Kent Kidder, Bryant Paper Company; W. A. (Spike) Kelly, E. D. Jones Sons Company; Henry Kennedy, Chase Coal Company; K. J. Kimball, Improved Paper Machinery Corporation; Lester LaLiberte, Kalamazoo Vegetable Parchment Company; Lloyd Lynd, Sturtevant Mill Company; Joe Loughead, Loughead Company; Tom Latimer, Black Clawson Company; Dave Murchison, New York; M. C. Mulder, Allied Paper Mills; L. J. Maurer, Consolidated Paper Company; Bob Milroy, Sergeant Coal Company; Howard Mayshaw, Bird Machine Company; Chas. McAleer, Sutherland Paper Company; Allen Milham, Bryant Paper Company; L. M. Mongrieg, U. S. Rubber Company; Sam Myers, Sutherland Paper Company; Henry Nendorf, Rex Paper Company; Chas. Noble, Staley Starch Company; S. P. Newcomer, Consolidated Paper Company; Al Perlick, Kal. Vegetable Parchment Company; Harry Pearson, Pioneer Paper Stock Company; Dick Poleys, Shartle Brothers; Allen Patton, Frasier Industry; Jake Parent, Noble & Wood Machine Company; Tom Quinn, Sutherland Paper Company.

A. C. Rowen, Bond Supply Company; Ed. Rutz, Bryant Paper Company; Henry Reeves, Hercules Powder Company; E. M. Root, Dilts Machine Works; Leslie Rayle, Wirick Lumber Company; M. J. Roe, Bond Supply Company; H. E. Stratton, PAPER TRADE JOURNAL; C. Baldy Smith, Huron Milling Company; Frank Stowith, Michigan Carton Company; Robert Sorlie, Loughead Company; Carl Swanson, Allied Paper Mills; R. W. Shew, Otsego Falls Paper Company; William Shaw, Michigan Carton Company; Homer Stafford, Kalamazoo, Mich.; Harold Sinclair, American Cyanamid Corporation; Glen Sutton, Sutherland Paper Company; Walter Shaw, Heller & Merz; Paul Schrieber, General Dye Stuff; Al Sherwood, Sutherland Paper Company; C. F. Simmerer, Titanium Pigment Corporation; Ed. Sergeant, Sergeant Coal Company; C. M. Treat, Bond Supply Company; James Tolhuizen, First National Bank; E. B. Taylor, American Cyanamid Corporation; Fred Wirick, Sutherland Paper Company; Joe Wiedmeyer, Allied Paper Mills; E. C. Wilbur, Bond Supply Company; Jack Wendtke, Heller & Merz Company; Art Woollam, A. E. Woollam Company; Don Wilson, Sutherland Paper Company; E. B. Woodruff, Woodruff Coal Company; Clint Wainwright, Allied Paper Company; Arnold Weller, Sutherland Paper Company; Merle Wilkins, Bryant Paper Company and Chas. Yonker, Allied Paper Company.

"Weightless", floating suspension of 18" main turbine leads by GENSPRING Constant-Support Hangers. Steam pressure 1350 lbs.; temperature 910° F.

18 TONS OF POWER PIPING FLOAT IN PERFECT BALANCE

New-type engineered suspensions provide constant, unrestricted support!

No longer is it any problem to install heavy power piping so that neither dead-weight nor extreme thermal expansion can cause added stresses in the pipe. Grinnell GENSPRING Hangers now provide suspension so accurately-balanced and free-moving that the pipe hangs virtually "weightless" in the system!

Take the installation pictured here, for example. GENSPRING Hangers, in simple series-parallel arrangement, furnish constant, "floating" support throughout a 4" vertical expansion range, for two 9-ton main steam leads to a high pressure turbine.

Unlike old-style, variable-support hangers, GENSPRING Hangers balance the weight of pipe in every "hot" and "cold" position. Their patented non-resonant mechanism eliminates weight-stress due to thermal movement . . . helps to absorb vibration . . . effectively increases safety factor.

Write for full details of GENSPRING Constant-Support Hangers made for loads from 250 to 8500 pounds. Grinnell Co., Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

Write for data book on GENSPRING Hangers and piping-travel calculations.

GENSPRING CONSTANT-SUPPORT HANGERS BY **GRINNELL**

WHENEVER **PIPING** IS INVOLVED

Government Paper Bids and Awards

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., July 23, 1941—Government Printing Office has received the following bids for 1,064 pounds of 35 x 45 goldenrod coated book paper: Mudge Paper Company, 12.8 cents; Whitaker Paper Company, 13.05 cents; Mathers-Lamm Paper Company, 13.5 cents; and Stanford Paper Company, 14.75 cents.

For 10,000 sheets of 20 x 26 one side red glazed paper; Whitaker Paper Company, $9.08, $8.66, $9.29 per M sheets: Whitaker Paper Company, $11.40; and Mudge Paper Company, $13.26.

For 88,750 pounds of 25% rags, 32½ x 42½ mimeograph paper: Old Dominion Paper Company, 8.15 cents; and Mudge Paper Company, 9.5 cents.

For 15,000 sheets of 22 x 28 gray photo mount board; Mathers-Lamm Paper Company, $37.11 per M sheets; George F. Muth & Company, $40.00 less 2%; Whitaker Paper Company, $40.28; Mudge Paper Company, $40.50; R. P. Andrews Paper Company, $38.53; Barton, Duer & Koch Paper Company, $40.75; and Milton Bradley Company, $55.12.

For 10,000 pounds of 19 x 24 moss green desk blotting paper: R. P. Andrews Paper Company, 7.97 cents; Mudge Paper Company, 6.43 cents; Whitaker Paper Company, 6.05 cents; Butler Company, 7.313 cents; Graham Paper Company, 7.25 cents; and Virginia Paper Company, 6.5 cents.

Government Printing Office has announced the following paper awards.

Old Dominion Paper Company will furnish 74,000 pounds of 32 x 42, 25% rag, white bond paper at 11.979 cents. Mudge Paper Company will furnish 100,000 pounds of 44 x 64 white offset book paper at 7.3 cents. R. P. Andrews Paper Company will furnish 12,150 pounds of 36 x 46 cream bristol board at 5.95 cents. Bids for these items were received on June 27.

Barton, Duer & Koch Paper Company will furnish 19,274 pounds of 38 x 48 white M.F. lithograph paper at 7.37 cents. Marquette Paper Company will furnish 206,500 pounds of 40 x 50, one side, white coated book paper at $18,481.75. Mudge Paper Company will furnish 6,233 pounds of 50% rag, 32 x 48½ white ledger paper at 15.35 cents. Eastern Corporation will furnish 28,508 pounds of 31½ x 48 white sulphite writing paper at 8.58 cents. Bids for these items were received on June 25.

Eastern Corporation will furnish 230,000 pounds of 32 x 42 white sulphite writing paper at 6.79 cents, bids for which were received on June 23.

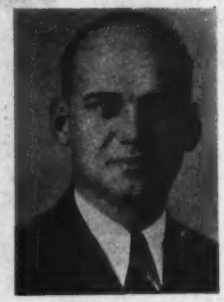
Stanford Paper Company will furnish 8,100 pounds of 14 x 20, 50% rag, white lithograph finish map paper at 14.56 cents. Barton, Duer & Koch Paper Company will furnish 5,700 pounds of 18 x 37 white sulphite writing paper. Mudge Paper Company will furnish 5,000 pounds of 50% rag, 28 x 34 blue manifold paper at 16.98 cents. Cauthorne Paper Company will furnish 40,000 pounds of 31½ x 48 chip board at 20.86 cents. Bids for all of these items were received on June 20.

Stanford Paper Company will furnish 120,000 pounds of 25% rag, white bond paper in 32 inch rolls, at 10.79 cents, bids for which were received on June 18.

Stanford Paper Company will furnish 23,700 pounds of 50% rag, 36 x 44 lithograph finish map paper at 13.75 cents and Mudge Paper Company will furnish 32,000 pounds of same 75% rag, 36 x 52 at 14.86 cents. Bids for these items were received on June 16.

Returns from South America

Harry Vernon has just returned from an extended South American trip of several months. He visited Argentina, Uruguay, Brazil, Peru, Chile and Colombia and has come back crowded with full information as to trade in those countries. Mr. Vernon found increasing demand for American products and the buyers showed every desire to cooperate with American manufacturers in accepting American standards and qualities. Mills which are desirous of building up permanent South American connections will undoubtedly find it to their advantage to discuss this business with Mr. Vernon, for Parsons & Whittemore, Inc., are well represented throughout all Central and South American countries by aggressive agents thoroughly familiar with all angles of the Central and South American paper trade.



Paper Shortage Predicted

The Office of Production Management was reported to have stated that a shortage of most types of paper was impending as a result of the war and the defense program.

Newsprint supplies may be curtailed by transportation difficulties, officials said, although Canadian production is less than capacity and is being increased. A shortage in book, writing and some other types of paper was attributed largely to increased demand and the cutting off of imports from Norway.

C. W. Boyce, assistant chief consultant of the OPM paper and pulp section, reported that there was a serious shortage of ships for transportation of newsprint and pulp from Canada and that the rail transportation situation would become rather serious as facilities became congested with defense shipments.

The OPM moved to remedy a serious shortage of locomotives with blanket priority orders giving locomotive builders and locomotive repair plants preference on delivery of materials.

Charles W. Boyce Resigns

Charles W. Boyce, secretary-treasurer of the Kraft Paper Association, 122 East 42nd street, New York, has resigned to devote his whole time as assistant chief consultant of the Pulp and Paper Division of the Office of Production Management, Washington, D. C.

Mr. Boyce, formerly executive secretary of the American Paper and Pulp Association, became secretary of the Kraft Paper Association in February, 1941. His resignation was effective on July 1.

The office of the Kraft Paper Association will continue in charge of Dernell Every as assistant secretary.

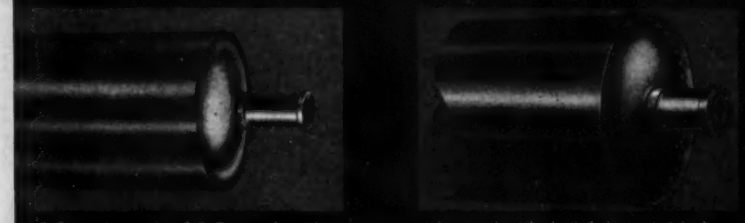
Check Chart FOR DRYERS

● It is our contention that Black-Clawson seamless dryers have certain definite advantages over the ordinary bolted head dryer. That more than 18,000 B-C seamless dryers have been sold ***with but one known operating failure,*** goes far to support our belief.

On this page is your opportunity to compare dryers. Do so and we believe the next time you need dryers you'll insist on Black-Clawson seamless. ***The Black-Clawson Company, Hamilton, Ohio. Shartle Division, Middletown, Ohio. Dilts Division, Fulton, N. Y.***

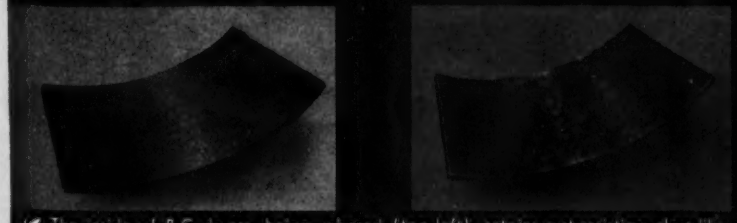
B-C seamless dryers are turned in balance (above left), require no balance weights as do bored dryers (above right). 77 twenty year old B-C dryers were recently checked for true. None was off more than .041", the average much less. ***Seamless dryers stay in balance.***

After 40 years of hard service, this B-C dryer withstood 550 lbs. P. S. I. before it burst. Note that heads did not go out. ***Seamless dryers are stronger—meet ASME and all state codes.***



Since journals of B-C seamless dryers are cast integral with shell (above left) they withstand higher steam pressures. Bolted head dryers (above right) are seldom completely tight. Water oozes through, making them unsuited for higher steam pressures. ***Seamless dryers cannot leak.***

Heads of B-C dryers are close to end of face. There is no large projecting flange to interfere with uniform drying to edge of shell. ***Uniform Drying is a Seamless Advantage.***



The inside of B-C dryers, being unbored (top left), retains rust-resisting glass-like film, speeds up heat transfer. Bored dryers (top right) quickly rust, cut down on drying efficiency. More oil and film clings to this surface. ***Seamless dryers are cleaner, give greater heat transfer.***

B-C dryers are now equipped with large, easily read plate with full data as to strength and other operating details. ***Seamless dryers cut down on operating uncertainties.***

BLACK-CLAWSON SEAMLESS DRYERS

Chlorine Plan Outlined

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., July 21, 1941—Conforming with plans of the Office of Production Management to curtail the supplies of chlorine, used as a bleaching agent in book, writing and some other types of paper, Frederick I. Brower, Mill Representative of Atlantic Gummed Paper Corporation, whose offices are in the Drexel Building, has sent out a letter to all customers which reads as follows: "The following is substantially what all of our kraft mill suppliers have written us regarding the color of future deliveries: 'It is our earnest desire to cooperate fully with the Government in the matter of national defense; therefore we are complying with the telegraphic request of O. P. M. dated June 12, and have reduced the consumption of chlorine in the manufacture of our paper 10%. Obviously, we intend to cooperate with any future government requests for further chlorine reductions. We cannot maintain the usual brightness but, insofar as we are able we will match runs in color. The reduction in the quantity of chlorine used will, of course, reduce somewhat the brightness of color and increase dirt count.'" Continuing, the letter says: "While the change will be gradual, it will be a general condition in the industry, and this information may be helpful in the event that your customers criticize the color of the kraft."

Take Steps To Form Paper Committee

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., July 23, 1941—First steps leading to the formation of a paper and pulp defense advisory committee were taken at a meeting last week of about 50 industry members with officials of the OPM.

A 12-man group representing the manufacturers will be nominated and approved by the OPM, following a similar nomination by representatives of the paper converting industry. Graphic arts companies will also have a 12-man committee. The over-all paper and pulp defense committee will be created when the sub-groups have been organized.

The possibilities that a shortage of chemicals will cause dislocations and decreased production of paper were discussed at the meeting with the pulp men, OPM officials disclosed.

Returns From Far East

L .W. Bowmall, president of Bowmall & Co., 250 Park avenue, New York, has returned from a five and one-half months trip to the Far East.

In his travels Mr. Bowmall visited the Philippine Islands, China and Japan. In attempting to return home through Europe he traveled through Chosen, Manchuko and Siberia, getting as far as Moscow. Unable to proceed further, Mr. Bowmall was obliged to travel the entire distance across Siberia to Vladivostock and thence to Japan to reach the United States.

Italy Conserves Paper

Paper, cardboard and wood pulp factories in Italy have been ordered to suspend operations for one week out of each month as well as Sundays to conserve paper. Manufacture of many fine papers was forbidden. The size of daily newspapers and periodicals is to be controlled also.

Shipping Situation More Acute

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., July 21, 1941—Canadian newsprint manufacturers are beginning to feel the pinch of a tightening in the supply of available cargo space for overseas markets. As a matter of fact, the question was raised quite some time ago, but it was said that no serious situation had arisen. However, as has been pointed out so often, newsprint and pulp are bulky products, and occupy a correspondingly larger amount of space than most other weighty products and along with sharply higher ocean freight rates, has had a tendency to cut down the demand for Canadian paper.

Essential defense materials have first call on available shipping space and newsprint and allied products rank far down the line of priorities. Shipping space for cargo destined for almost any point of the compass is affected by the demands of the war, as was to be expected. There is an exception, however, in the case of South American countries. In this case disturbance due to the European conflict has resulted in a greater amount of north-bound traffic and Canadian manufacturers do not have the same difficulty in obtaining space for south-bound shipments.

Canadian Newsprint Production

WASHINGTON, D. C., July 21, 1941—Canadian newsprint mills averaged 79 per cent of capacity in 1940 operation, and tonnage production surpassed the preceding year by 19 per cent.

The mills operated at about two-thirds capacity in the first three months of the year, but with blocking of Scandinavian sources of supply in April, the demand in the United States, South America and other markets increased. Operations in Canadian mills rose to 91 per cent of capacity in July, the year's peak. In succeeding months consumption in the important American market showed less than the anticipated demand, and publishers' stocks rose to unusually high levels.

KVP to Build

KALAMAZOO, Mich., July 21, 1941—Contract for the Kalamazoo Vegetable Parchment Company's new building has been awarded to the Miller-Davis Company, is was announced last week by Ralph A. Hayward, president of KVP.

Excavation is being done by the paper company, while the contract awarded to Miller-Davis is at a figure of approximately $65,000 for actual construction. KVP also will improve the grounds and pave the street leading to the building.

Construction is to start in about four weeks, with the building scheduled to be completed by the first of the year. Measuring about 100 by 350 feet, it will be erected in connection with Mill No. 2. The structure will be used for storage and shipping.

"Grid" Blast Coils

The D. J. Murray Manufacturing Company, Wausau, Wis., has issued a "Grid" Blast Coils catalog. It describes in detail Grid Blast Coils, with engineering data and capacity tables for twenty-five different installation setups for 5 to 250 lbs. of steam. Also described is the Murray Air Washer arranged with the Grid Blast Coils. Copies are available upon request to the company.

THE TEST
that upset the Turbine Oil applecart

...PROVES NEW SHELL TURBO OIL PREVENTS RUST

THE 4 steel test strips shown prove that Shell Turbo Oil positively prevents rusting. All 4 strips were immersed for 48 hours at 167° F. in 4 well-known turbine oils, mixed with 10% of distilled water, and continuously agitated at 1200 R.P.M. Top strip, immersed in Shell Turbo Oil under these severe test conditions, shows no rust. All other strips were badly rusted.

GET THE DETAILS TODAY!

SHELL

SHELL TURBO OIL

FINANCIAL NEWS

New York Stock Exchange

High, Low and Last for Week Ending July 23, 1941

	High	Low	Last
A. P. W.	1½	1½	1½
Armstrong Cork Co.	29¼	28¾	29
Celotex Corp.	9⅜	9¼	9¼
Celotex Corp., pf.	70⅞	70	70
Certain-Teed Products Corp.	3¾	3¼	3½
Certain-Teed Products Corp., pf.	35	31½	32½
Champion Paper & Fibre Co.	21¾	20½	21½
Champion Paper & Fibre Co., pf.	103	103	103
Congoleum-Nairn Co.	16⅝	15½	15½
Container Corp. of America	16½	15⅝	16⅜
Continental-Diamond Fibre Co.	9⅛	8⅝	8⅝
Crown-Zellerbach Co.	14⅜	13½	14
Crown-Zellerbach Co., pf.	86¼	85½	86¼
Flintkote Co.	15½	14¾	15
Robert Gair	2⅜	2	2⅜
Robert Gair, pf.	10¾	9⅜	10¼
International Paper & Power Co.	19	16¾	18¼
International Paper & Power, pf.	69¼	66¾	68⅛
Johns-Manville Corp.	68½	65	68
Johns-Manville Corp., pf.	127	127	127
Kimberly-Clark Corp.	30	29¾	30
MacAndrews & Forbes	25½	25½	25½
MacAndrews & Forbes, pf.	....	....	....
Masonite Corp.	24¾	24¼	24½
Mead Corp.	9½	9	9
Mead Corp., pf.	70	70	70
Paraffine Companies, Inc.	....	....	....
Paraffine Companies, Inc., pf.	101	101	101
Rayonier, Inc.	15⅝	14½	15⅜
Rayonier, Inc., pf.	28⅜	27½	28¼
Ruberoid Co.	17⅞	17½	17⅞
Scott Paper Co.	35⅞	35⅜	35⅞
Scott Paper Co., pf.	111½	111½	111½
Sutherland Paper Co.	21¾	21¾	21¾
Union Bag & Paper Corp.	12¾	11⅝	12¼
United Paperboard Co.	4	3¾	4
U. S. Gypsum Co.	61	58½	61
U. S. Gypsum Co., pf.	175½	175½	175½
West Virginia Pulp & Paper Co.	20¾	20	20¼

New York Curb Exchange

High, Low and Last for Week Ending July 23, 1941

	High	Low	Last
American Box Board Co.	5⅞	5⅜	5⅞
Brown Co., pf.	20	18⅛	20
Great Northern Paper Co.	36½	36½	36½
Hummel-Ross Fibre Corp.	6⅜	6	6¼
National Container Corp.	12½	12	12½
St. Regis Paper Co.	2⅛	2	2⅛
St. Regis Paper Co., pf.	96½	96	96½
Taggart Corp.	3¼	2¾	3

Abitibi Earnings Lower

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., July 21, 1941—The Abitibi Power and Paper Company reports earnings for June, prior to audit and charges for depreciation and bond interest, at $718,109, as compared with $752,858 in the preceding month and $885,862 in June of last year. Included in earnings for June, it is stated, is $136,606 received as premium on United States exchange.

For six months ended June, earnings on above basis were $3,849,132 as compared with $3,327,229 in the first half of 1940.

Shipments of newsprint in June, according to G. T. Clarkson, receiver and manager, were 35,384 tons compared with 35,494 tons in May, and 48,946 tons in June, 1940. Present indications are that shipments of newsprint will be about 35,500 tons in July, compared with 46,168 tons in July, 1940.

Shipments of sulphite pulps in June amounted to 7,220 tons against 7,359 tons in May and 6,658 tons in June, 1940. Present indications are that shipments of sulphite pulp will amount to about 8,200 tons in July, against 7,472 tons in July, 1940.

Keyes Fibre Nets $143,749

The Keyes Fibre Company for the six months to June 30 reports a net profit of $143,749, against $120,246 earned in first half of last year.

Johns-Manville Profits Up

The Johns-Manville Corporation reports for the second quarter a consolidated net income of $1,457,213, equal after preferred dividends to $1.62 a common share, against $1,110,319, or $1.17 a share, in the 1940 period. Net profit for the first half of 1941 was $3,018,801, or $3.35 a common share, against $1,888,013, or $1.93 a share.

Lewis H. Brown, president, said net sales for the second quarter were $22,099,463, which is 46.3 per cent above the sales of $15,105,379 in the 1940 period. For the six months sales were $38,812,510, against $26,644,992, a rise of 46 per cent.

Net income before Federal and Canadian income and excess profits taxes was $7,631,466 for the six months, against $3,028,749 in the 1940 period, a gain of 152%. Wages and salaries were $12,945,298 against $9,637,549, a gain of 34.3%. The income and excess profits tax provisions were $4,612,664, computed upon the best information available as to rates likely to be applied to 1941.

The Johns-Manville Credit Corporation, a wholly owned but non-consolidated subsidiary, earned $64,950 in the first half of 1941, against $54,216 in the 1940 period.

Earnings Statement Available

The Southern Advance Bag and Paper Co., Inc., a Maine corporation, with general offices at 38 Newbury street, Boston, Mass., has made generally available to its security holders an earnings statement for the twelve months ended May 31, 1941. Such earnings statement covers a period of twelve months beginning after the effective date (May 9, 1940) of the Company's Registration Statement for $3,200,000 principal amount of its First Mortgage Sinking Fund Bonds, 4½% Series due 1955, filed under the Securities Act of 1933, as amended, and is made generally available to security holders in accordance with the provisions of Section 11 (a) of said Act. Copies of such earnings statement will be mailed on request to holders of the Company's securities.

Hinde & Dauch Profits Up

A new peak in sales for the first half of this year is seen for Hinde & Dauch Paper Company. Sales are reported at around $9,300,000, which is 30% above the same 1940 period and exceeding the previous peak in 1937.

Net profits are expected to be about $517,000 or $1.20 a share after 30 per cent income tax reserve and estimated excess profits tax. In the first half last year net was $462,319 or $1.03 a share and for the full year $975,458 or $2.21 a share. The board manufacturers of the company are operating near 100% capacity and the board converters at about 65% capacity.

Current output of container manufacturer at present is limited by the inability to obtain board rather than by the demand for boxes.

Instrumentation Studies. XXXVIII*

The Thwing Initial Tear Tester

By the Staff of The Institute of Paper Chemistry

Abstract

The accuracy and reproducibility of the Thwing initial tear tester and the effect of certain variables on the operating technique have been investigated. Increasing the width of the specimen in general tended to increase the instrument reading. The testing of several strips simultaneously gave inconsistent results. The initial tearing strength of papers and boards correlated in a general way with tensile strength and with the force required to continue a tear. An analysis of stresses shows that initial tearing strength is largely dependent on tensile strength and stretch.

Tearing resistance of paper is commonly evaluated by means of an instrument which measures the work required to continue, through a specified distance, a tear which has been started in one edge of the specimen. Brecht and Imset *(1)* have described a "through-tear" tester in which the center of the specimen is ruptured with a ram actuated by a falling pendulum. The instrument supposedly measures the forces required to start and to continue the tear.

Beach *(2)* has described an instrument developed by the General Electric Company to indicate the resistance of boxboard to puncture. Although this is not strictly a tear test, it may evaluate characteristics similar to those measured by the "through-tear" tester already mentioned.

The Thwing initial tear tester was designed to measure the force required to start a tear on the edge of a specimen, which approximates a failure frequently appearing under use conditions. In the investigation of this instrument, the objectives were to determine the accuracy and reproducibility of its results, to study the variables in operating technique, and to observe the correlation of results with those obtained by means of other instruments designed to measure similar or related properties.

From a consideration of the mechanics involved, a tear should be caused by a force which is pure shear. In other words, the forces acting on the specimen at the point of rupture should be perpendicular to the surface, resulting in a compression on one side of the sample and an opposed compression on the other side. In testing a specimen, such as heavy paper or light board, the stiffness of the specimen is not sufficient to result in pure shear, so that some tension will be set up in the sample. The farther apart the jaws holding the specimen, the greater will be the tensile resultant of the forces applied. Under such conditions, the test becomes more of an edge tensile than an initial tear.

Description and Operation

The Thwing initial tear tester is sturdily constructed. It has two jaws, each with a surface ¾ by 2½ inches, mounted one inch apart on horizontal shafts held in a rigid supporting framework (*see* Fig. 1). The jaws are so mounted that their surfaces are horizontal and one edge lies along the center line of the shafts. The back of each jaw is three fourths of an inch from this center line, allowing specimens to be inserted accurately before applying pressure by means of the tightening nuts.

A ratchet is attached to the shaft supporting the rear jaw, and a crank and pawl mechanism is provided to act upon this ratchet. In the starting position, a metal pin on the ratchet rests on the framework. The shaft carrying the other jaw supports a weighted pendulum and is connected by means of gears to a needle mounted on a dial at the front of the instrument. These gears amplify the motion of the pendulum so that the needle travels through a greater arc than that through which the pendulum passes. Riding on a small shaft of the gear assembly behind the dial is a strip of spring metal which through friction holds the needle in any given position. A stop engages the pendulum in a vertical position before each test, allowing the needle to be returned to the zero reading.

The specimen to be tested is clamped firmly in the jaws. The pendulum stop is released, and the crank is turned at a uniform speed, causing the rear jaw to rotate. Through the connecting test strip, the front clamp and the pendulum are also caused to rotate. The indicating needle moves until, at the instant of failure, the pendulum recedes toward the vertical position, the needle remaining at the position of maximum displacement. A reading is taken, the ratchet returned to the starting position, the stop inserted in the pendulum, and the needle moved back to the zero mark.

Calibration

The manufacturer had divided the dial of the instrument into arbitrary units which are not directly proportional to the force applied to the edge of the test specimen. The scale had been plotted by suspending weights from a knife edge inserted in the cross arm of the pendulum on the side opposite the

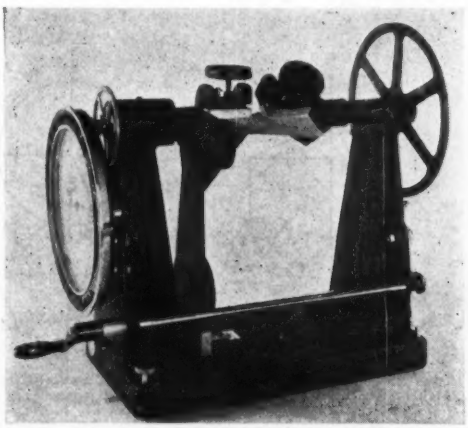


FIG. 1.
The Thwing Initial Tear Tester

* This report is one of a series issued as a part of the instrumentation program of the American Paper and Pulp Association.

clamp. This knife edge was placed at a point equal to five times the lever arm represented by the specimen clamp, or 3¾ inches. The knife edge was inserted in the lower of two holes provided in the side arm. By applying one-pound increments of force, five major divisions were laid out on the dial, and the spaces between these were uniformly divided until 20 units were obtained. Then the knife edge apparently was shifted to the upper hole of the side arm, and the remaining units laid out as before. The resulting units on the dial are progressively smaller in groups of five until 20 is reached. Between 20 and 25, the units are larger again, and from 25 they continue to decrease in groups of five until 50 is reached.

An analysis of the calibration shows the error in this method. In Fig. 2*a* (a diagrammatic sketch of the displacement of the pendulum) the moments of the forces about the axis of rotation O may be expressed as follows:

$$M_1 = ms = mh \sin \theta, \text{ and}$$
$$M_2 = wy = wz \cos \theta,$$

where M_1 is the moment required to displace the pendulum of weight m through an angle of θ degrees; and
M_2 is the moment due to the weight w applied on the cross arm z whose effective lever arm is y.

At equilibrium,

$$M_1 = M_2, \text{ or}$$
$$mh \sin \theta = wz \cos \theta, \text{ or}$$
$$\frac{\sin \theta}{\cos \theta} = \tan \theta = wz/mh.$$

Since z, m, and h are constant for the range from 0 to 20 on the dial,

$$\tan \theta = kw, \text{ or}$$
$$\theta = \tan^{-1} kw.$$

Accordingly, as w becomes larger, given increments of w result in progressively smaller increments of θ. This explains how the dial graduations from 0 to 20 acquired their form. A similar analysis may be applied to the system after the knife edge has been shifted to the upper hole.

The force which the instrument was designed to measure is theoretically tangential to the arc described by the rotating edge of the jaw. In order to apply this tangential force, a pulley was mounted on the jaw with the axis of rotation of the pulley corresponding to that of the jaw. Weights were suspended from a wire wound over the surface of the pulley. This arrangement is shown diagrammatically in Fig. 2*b*. Using the same notations as above, the moments of the forces around the axis of rotation O are

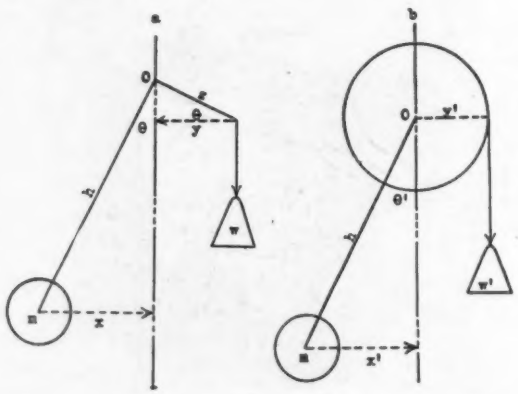


FIG. 2.
Force Diagram of Pendulum Displacement

$$M_1 = mx' = mh \sin \theta', \text{ and}$$
$$M_2 = y'w'.$$

At equilibrium

$$M_1 = M_2, \text{ or}$$
$$mh \sin \theta' = y'w', \text{ or}$$
$$\sin \theta' = y'w'/mh.$$

Since y', m', and h are constant,

$$\sin \theta = k'w', \text{ or}$$
$$\theta = \sin^{-1} k'w'.$$

Accordingly, as w' becomes larger, given increments of w' result in progressively *larger* increments of θ'.

By this method, the instrument was recalibrated in terms of a tangential application of weights in one-pound increments so that a relationship could be established between the dial reading and the actual tangential force exerted on the specimen. These data are shown in Table I. The maximum initial tear which the instrument can measure is about 35 pounds, rather than 50 as shown on the dial.

All values of initial tear in this report are given in terms of the corrected reading expressed as pounds.

Application of Instrument

All determinations in this investigation were performed at a relative humidity of 65% and 70 deg. F. Samples were conditioned in this atmosphere for at least fifteen hours before testing. A description of the various samples including some of the physical characteristics commonly measured will be found in Tables V and VI.

TABLE I.—RECALIBRATION OF INSTRUMENT.
Width of jaw—0.75 inch
Radius of pulley—2.38 inches
Tangential force at edge of clamp equals force applied to pulley times 3.17

Force Applied to pulley lb.	Tangential force at edge of clamp lb.	Dial reading
1	3.2	3.5
2	6.3	6.7
3	9.5	9.9
4	12.7	13.3
5	15.9	17.3
6	19.0	21.3
7	22.2	25.0
8	25.4	29.5
9	28.5	35.0
9.807	31.1	39.8
10.865	34.4	47.4

The term "machine direction" as applied to the various tests means that the specimens were so cut that the line of rupture or the axis of bending was perpendicular to the machine direction. The term "cross direction" as used has a corresponding significance.

Effect of Strip Width

In the study of the effect of strip width, each sample was evaluated in two widths: 1.5 by 6 inches and 3 by 6 inches. The rate of loading was 60 r.p.m. of the hand crank. Each sample was evaluated in both directions. The 3 by 6-inch strip was again evaluated, using the opposite edge from which the first reading was obtained. On sample 26 the ¾-inch portion, which had been torn, was cut off reducing the strip size to 2.25 by 6 inches.

The data are presented in Table II. Sample 11, a jute tag, showed a small decrease in the initial tearing resistance on increasing the strip width. The three board samples gave as much as 60% increase in initial tear upon creasing the strip width. This increase might have been due to the greater rigidity of the wider specimens, resulting in a lesser tendency for them to be distorted by the stresses applied. It is not apparent, however, why this effect did not appear

TABLE II.—EFFECT OF STRIP WIDTH—AVERAGE OF 30 TESTS

I = Machine; II = Cross

Number	Sample	1.5 by 6 inches I	1.5 by 6 inches II	3 by 6 inches I	3 by 6 inches II	Reverse Side 3 by 6 inches I	Reverse Side 3 by 6 inches II
11	Jute tag	6.2	4.9	5.9	4.4	5.9	4.4
22	45-point jute single-lined board	9.9	7.2	10.3	8.7	10.2	8.9
24	80-point board with 16-point jute liners	18.9	12.7	20.9	20.6	20.9	20.3
26	60-point board with 16-point kraft liners	15.0	11.7	16.4	15.2	16.0*	14.5*

* Reduced to 2.25 by 6 inches after one tear per strip was determined.

in the tests on jute tag, or why the effect was more pronounced in the cross-direction tests of the heavier board samples.

When the 3 by 6-inch specimens were reversed and evaluated on the opposite edge, the initial tear values were nearly identical. Cutting the torn edges from these strips so that they measured 2.25 by 6 inches decreased the initial tear somewhat.

By brief exploratory trials, it was found that the width of strip, beyond which any increase in width would not alter the initial tear appreciably, was approximately 3 inches. Since the evaluation of relatively wide specimens more nearly approximates use conditions this width was used throughout this investigation. By evaluating the specimen on both edges, the amount of sample required to make the test was greatly reduced without sacrificing accuracy of the determination.

To check the reproducibility of results, each sample was evaluated in three groups of ten. The greatest deviation of individual group averages from the mean was less than 6%, indicating that the average of ten readings would give a fairly reproducible initial tear value for these samples.

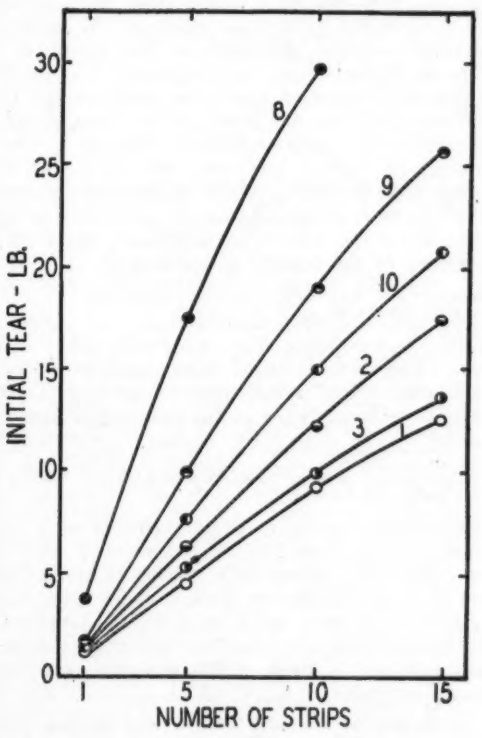


FIG. 3.

Relation of Initial Tear and Number of Strips—Machine Direction (*See* Table IV)

Throughout the remainder of this report, unless otherwise specified, all references are to determinations made on specimens 3 by 6 inches, every strip being tested once on each 6-inch edge.

EFFECT OF LOADING SPEED

As the load is applied to the test specimen, the pawl which acts on the driving ratchet imparts a small impulse at each revolution of the crank. In most cases, when the point of rupture has nearly been reached, the impulse from the pawl carries the pendulum forward, and, while the pawl is moving back to engage the next tooth, the pendulum falls back slightly leaving the needle in the maximum position. On the next impulse, the sample may tear, yet the needle will not move to a higher value. The accuracy of the determination, using this method of loading, is questionable.

To investigate the effect of loading through a direct drive, either manually or with a motor, was considered beyond the scope of this investigation.

Two speeds that could be applied conveniently by cranking were 60 and 120 r.p.m. of the crank. Fifty tests were made on each of five samples in both the machine and cross direction at these two speeds. The samples selected had initial tear values covering the range of the instrument.

The results are presented in Table III. The statistical formulas used were

$$r = 0.6745\sqrt{(\Sigma x^2)/(n-1)},$$
$$r' = 100r/\text{arithmetic mean, and}$$
$$R = r'/\sqrt{n'},$$

where

r is the probable error of an individual reading from the arithmetic mean,
x is the deviation of an individual reading from the arithmetic mean,
n is the number of specimens tested,
r' is the percentage probable error of an individual determination, and
R is the percentage probable error in the mean of n' determinations.

The percentage of probable errors of an individual determination and of the mean of ten determinations was small, indicating good reproducibility of results.

TABLE III.—EFFECT OF LOADING SPEED AND REPRODUCIBILITY OF RESULTS.

n = 50 determinations

I Direction
II Speed of loading — r.p.m.
III Tearing strength arithmetic mean — lb.
IV r — Probable error in individual determination — lb.
V r' — Percentage probable error in individual determination
VI R — Percentage probable error of mean when 10 specimens are tested

No.	Sample*	I	II	III	IV	V	VI
11	Jute tag	Machine	60	6.7	0.237	3.5	1.1
		Machine	120	6:5	0.353	5.4	1.7
		Cross	60	4.4	0.212	4.8	1.5
		Cross	120	4.8	0.219	4.6	1.5
20	50-point single-lined board	Machine	60	11.6	0.432	3.7	1.2
		Machine	120	12.0	0.525	4.4	1.4
		Cross	60	9.7	0.424	4.4	1.4
		Cross	120	10.0	0.487	4.9	1.6
23	60-point board	Machine	60	18.4	0.576	3.1	1.0
		Machine	120	18.5	0.643	3.5	1.1
		Cross	60	15.5	0.442	2.9	0.9
		Cross	120	15.8	0.380	2.4	0.8
21	100-point board	Machine	60	21.3	0.527	2.5	0.8
		Machine	120	21.6	0.441	2.0	0.6
		Cross	60	22.3	0.409	1.8	0.6
		Cross	120	22.3	0.508	2.3	0.7
25	100-point board	Machine	60	28.1	0.695	2.5	0.8
		Machine	120	28.5	0.840	2.9	0.9
		Cross	60	28.7	0.430	1.5	0.5
		Cross	120	28.4	0.565	2.0	0.6

* See Tables V and VI for more complete description of samples.

There were no significant differences in the magnitude or in the reproducibility of the results at the two speeds of loading. Inasmuch as 60 r.p.m. is the more convenient rate of cranking, this speed was used in all other tests of initial tearing strength given in this report, and results are the average of ten readings.

Effect of Number of Strips

The initial tear tester is not designed to give an adequate reading for lightweight papers when only one strip is evaluated. The effect of increasing the number of strips to increase the initial tear value was studied by evaluating lightweight papers using one, five, ten, and fifteen strips for each reading. The results are presented in Table IV and in Fig. 3.

Increasing the number of strips did not give an exactly proportional increase in the initial tear. This can be seen from Fig. 3, where the initial tear is plotted against the number of strips in the machine direction. By comparing the figures of Table IV, in which all readings have been reduced to the basis of one strip, it is evident that varying the number of strips used in evaluating initial tear does not give consistent results.

No general conclusions can be drawn from the data except that it does not seem feasible to determine initial tear on lightweight papers with this instrument. By redesigning the instrument to use a smaller pendulum weight, a more dependable value of initial tear on lightweight sheets might be obtained.

TABLE IV.—EFFECT OF NUMBER OF STRIPS

Average of 10 Readings

No.	Sample Strips	Initial Tear—lb. Machine direction One	Five	Ten	Fifteen	Cross Direction One	Five	Ten	Fifteen
					Actual Reading				
1	White sulphite envelope ..	0.9	4.4	9.2	12.6	1.0	4.5	9.6	14.7
3	White sulphite ledger	1.0	5.2	9.8	13.5	1.3	7.2	13.5	19.0
2	White kraft envelope	1.1	6.2	12.1	17.6	1.2	6.1	12.0	18.9
10	Jute manila	1.3	7.7	14.9	20.7	1.2	6.3	13.1	19.9
9	Kraft wrapping	1.5	9.8	19.1	25.8	1.3	7.3	16.0	22.6
8	Kraft folder	3.7	17.5	29.7	...	2.6	17.1	29.8	...
					One-Strip Basis				
1	White sulphite envelope ..	0.9	0.88	0.92	0.84	1.0	0.90	0.96	0.98
3	White sulphite ledger ...	1.0	1.04	0.98	0.90	1.3	1.44	1.35	1.27
2	White kraft envelope	1.1	1.24	1.21	1.17	1.2	1.22	1.20	1.26
10	Jute manila	1.3	1.54	1.49	1.38	1.2	1.26	1.31	1.33
9	Kraft wrapping	1.5	1.96	1.91	1.72	1.3	1.46	1.60	1.51
8	Kraft folder	3.7	3.50	2.97	...	2.6	3.42	2.98	...

Effect of Other Variables

A heavy clamping pressure may be applied to the specimen. The area of each jaw is large and the provision of large tightening nuts on the ruggedly designed clamps facilitates adequate manual tightening to prevent slippage of the specimen.

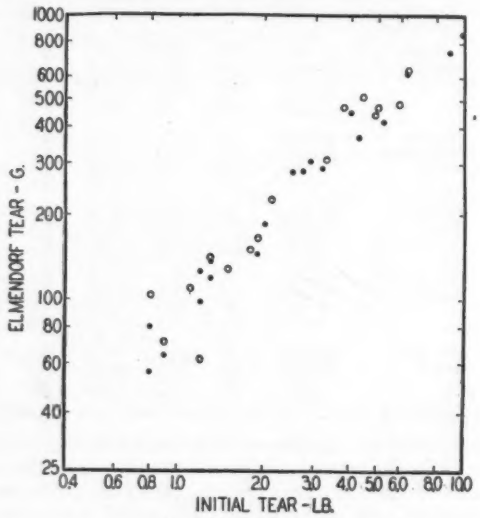


FIG. 4.

Initial Tear vs. Elmendorf Tear
○ Machine Direction ● Cross Direction

The construction of the instrument does not permit moving the jaws in a direction parallel with the axis of rotation. There appeared to be no convenient means of varying the distance between the jaws which would not displace the axis of rotation of the specimen. Moving the jaws closer together would influence the direction of the forces acting on the specimen and the initial tearing resistance as measured by the instrument.

In order to obtain some idea of the variation of this distance between the jaws during the test, repeated measurements were made, first with no specimen inserted, and then under load conditions corresponding to a tangential force of 27.5 pounds. For convenience, a flexible strip of strap metal 6 inches by 0.75 inch by 0.0125 inch was inserted in the jaws instead of paper. The initial distance between the jaws was 1.003 inches. The average decrease under load was found to be 0.022 of an inch. In order to ensure duplication of test results among several instruments, it would seem desirable to reduce this variation or to control it within close limits.

A qualitative study was made of the effect of unevenness in the test edge of the specimen. By means of heavy shears, an impression was made in the edge of chipboard specimens deep enough to be plainly visible, but not deep enough actually to cut the fibers. The specimens were inserted in the instrument in such a way that this nick was equidistant from the jaws. Upon testing, the failure occurred no more frequently at this point than at other points along the edge. No significant effect on the magnitude of the reading was observed.

Correlation with Other Instruments

Twenty-five samples were selected for correlation of the Thwing initial tear tester with other instruments. The description of these samples and of all other samples used in this study are given in Table V.

The instruments used in this correlation were:

1. Elmendorf tear tester
2. Amthor tensile tester
3. Stretch attachment of Amthor tensile tester
4. Gurley stiffness tester.

Elmendorf tear and Amthor tensile were determined according to TAPPI Standard T 414 m-35 and T 404 m-36, respectively. Strips 15 mm. in width were used for the tensile tests, and the results were expressed in pounds per 15 mm. width. Gurley stiffness values were corrected for specimen weight according to the formula which was given in Instrumentation Studies XXXV. *(3)*

The heavy papers and boards used in this correlation in general had poor formation. This fact may have contributed to the nonuniformity in the ranking

indicated by the various instruments. However, plotting the data of Table VI (Fig. 4 to 7) indicates that:

1. There is an approximate relationship between initial tear and Elmendorf tear in the range covered by the normal capacity of the latter instrument.
2. There is an approximate relationship between tensile strength and initial tear which is different in the two directions of the sheet.
3. There is no direct relationship between percentage stretch and initial tear.
4. There is no definite correlation between stiffness and initial tear.

During an initial tearing resistance test, the test specimen is bent and stretched. Both the angle of bend and the extension vary from zero for filaments along the axis of rotation to maximum values for filaments in the edge to be torn. The resultant moment of force acting upon the pendulum is thus made up of two components: (*a*) that due to bending of the specimen and (*b*) that due to tensile stresses in the specimen. These stresses may be discussed with the help of the stress diagram given in Fig. 8. As shown, the tensile stress varies from zero at the axis of rotation to maximum in the edge of the specimen. Let the tension in a filament of width w and thickness t (thickness of specimen) be F. It may be shown that $F \cong w\,t\,E\ (1 - \sin\theta)$ approximately where E is the modulus of elasticity of the specimen. The tangential component, F_t, of this force contributes a moment equal to RF_t to the total moment acting upon the pendulum. It is easily seen that $F_t \cong w\,t\,E\ (1 - \sin\theta)\cos\theta$. Bending of the filament produces a tangential force, F_t', which contributes the moment RF_t'. An approximate analysis of shearing force

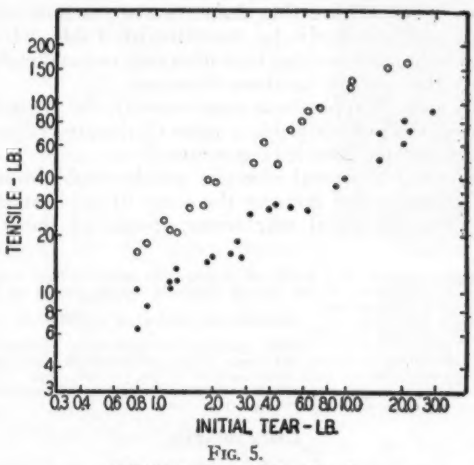


FIG. 5.
Initial Tear vs. Amthor Tensile
O Machine Direction ● Cross Direction

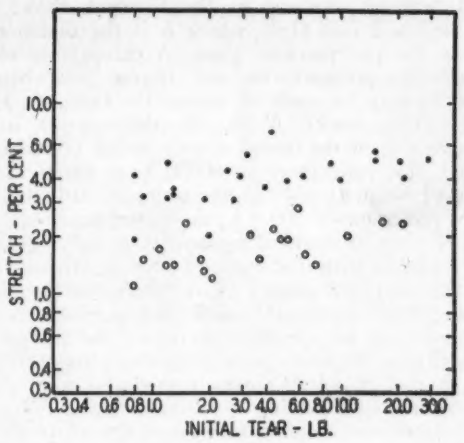


FIG. 6.
Initial Tear vs. Stretch
O Machine Direction ● Cross Direction

TABLE V.—DESCRIPTION OF SAMPLES

No.	Sample	Caliper 0.001 inch	Trade Basis Weight: Ream Size	Trade Basis Weight: Weight lb.	Basis Weight 25x40 —500 lb.
1	White sulphite envelope	4.2	17x22—500	24.8	66.3
2	White kraft envelope	3.7	17x22—500	19.8	53.0
3	White sulphite ledger	4.2	17x22—500	24.6	65.8
4	M.F. white litho	5.4	25x38—500	73.6	77.5
5	Bristol board	13.8	22.5x28.5—500	119	185
6	Bristol board	8.7	22.5x28.5—500	92	143
7	Buff Indian head cover	10.1	20x26—500	67	129
8	Kraft folder	10.9	20x26—500	71	136
9	Kraft wrapping	5.3	24x36—500	54	62
10	Jute manila	5.2	24x36—500	55	64
11	Jute tag	10.9	24x36—500	149	172
12	Sulphite liner	17.7	24x36—500	202	234
13	Sulphite liner	12.0	24x36—500	150	174
14	Kraft liner	11.6	24x36—500	131	152
15	Strawboard	10.7	26x38—500	120	122
16	Single-lined board	17.5	12x12—1000	66	230
17	Granite-finish board	24.8	12x12—1000	82	284
18	Granite-finish board	31.1	12x12—1000	106	368
19	Granite-finish board	44.4	12x12—1000	144	498
20	50-point single-lined board	48.1	12x12—1000	178	616
21	Pasted chipboard	95.4	12x12—1000	334	1159
22	45-point board, 16-point single jute liner	47.0	12x12—1000	167	578
23	60-point board, 16-point jute liners	62.5	12x12—1000	227	788
24	80-point board, 16-point jute liners	80.3	12x12—1000	287	981
25	100-point board, 16-point jute liners	98.4	12x12—1000	372	1293
26	60-point board, 16-point kraft liners	60.6	12x12—1000	194	664
27	80-point board, 16-point kraft liners	79.5	12x12—1000	268	919

TABLE VI.—CORRELATION OF INITIAL TEAR WITH OTHER PROPERTIES
I = Machine; II = Cross

No.	Sample	Initial Tear lb. I	Initial Tear lb. II	Elmendorf Tear g. I	Elmendorf Tear g. II	Amthor Tensile lb. I	Amthor Tensile lb. II	Stretch (Amthor) % I	Stretch (Amthor) % II	Gurley Stiffness (Corrected) g. I	Gurley Stiffness (Corrected) g. II
3	White sulphite ledger	1.2	0.8	62	56	21.1	10.4	1.4	4.1	0.19	0.07
4	M.F. white litho	0.9	0.9	71	63	18.1	8.4	1.5	3.2	0.41	0.17
5	Bristol board	1.9	1.2	166	126	39.0	11.1	1.3	3.1	5.68	1.45
6	Bristol board	1.8	1.9	150	144	28.3	14.6	1.5	3.1	1.96	0.84
7	Buff Indian head cover	1.3	1.3	142	138	20.8	11.6	1.4	3.5	1.47	0.79
8	Kraft folder	3.3	3.2	311	287	48.6	25.6	2.0	5.3	2.83	1.31
9	Kraft wrapping	1.5	1.3	127	118	27.7	13.3	2.3	3.3	0.30	0.15
10	Jute manila	1.1	1.2	110	97	23.7	10.3	1.7	4.8	0.32	0.12
11	Jute tag	5.9	4.3	485	366	82.0	29.3	2.8	7.1	4.83	1.39
12	Sulphite liner	5.1	2.9	475	304	72.5	15.2	1.9	4.1	15.36	3.27
13	Sulphite liner	2.1	2.0	226	185	38.1	15.4	1.2	2.0	5.40	2.15
14	Kraft liner	4.4	4.0	517	450	47.7	27.6	2.2	3.6	3.65	2.04
15	Strawboard	0.8	0.8	103	80	16.3	6.3	1.1	1.9	1.13	0.45
16	Single-lined board	4.9	2.5	442	278	73.4	16.2	1.9	4.4	13.32	2.65
17	Granite-finish board	3.7	2.7	473	282	63.1	18.7	1.5	3.1	24.46	6.57
18	Granite-finish board	6.4	5.2	632	419	92.0	28.1	1.6	3.9	50.76	13.24
19	Granite-finish board	7.3	6.3	...	617	92.6	27.3	1.4	4.1	73.54	20.81
20	50-point single-lined board	10.9	9.9	...	864	130	40.0	2.0	3.9	....	....
21	Pasted chipboard	21.6	22.2	...	...	...	72.0	..	4.0	....	....
22	45-point board	10.7	8.9	...	736	123	36.7	2.0	4.4	....	....
23	60-point board	18.7	15.5	...	...	...	50.0	..	5.0	....	....
24	80-point board	21.0	20.5	...	...	...	62.4	..	4.9	....	....
25	100-point board	28.1	28.8	...	...	...	81.0	..	5.0	....	....
26	60-point board	16.7	15.1	...	...	156	71	2.4	5.5	....	....
27	80-point board	21.2	20.6	...	...	164	81	2.3	4.9	....	....

and bending moment in the filament shows that $F_t' \cong E\,w\,t^3\,(\cos\theta)/b$, where b is the distance between the two pairs of jaws. A comparison of the relative importance of the tensile and bending stresses may be made by taking the ratio, $F_t/F_t' = (b^2/t^2)(1-\sin\theta)$. When the thickness, t, of the specimen is of the order of four points (0.004 of an inch), this ratio is about 60000 $(1-\sin\theta)$. If we take $(1-\sin\theta)$ to be of the order of 0.01, the ratio is of the order of 600, i.e., the contribution of bending stresses to the total moment is entirely negligible as compared with that caused by tensile stresses. This is the case for papers of ordinary thickness; the influence of stiffness is utterly negligible. As the thickness of the specimen increases, the role played by stiffness becomes theoretically more important. In the case of board 20 points in thickness, the relative contribution of bending is of the order of 5%. The contribution of bending in a board 0.1 of an inch in thickness is theoretically of the order of 50% of the total; however, a practical consideration indicates strongly, that the relative effect of bending is small, even in the case of heavy board. As mentioned in a previous section, the jaws of the instrument move toward each other a distance of about 0.02 of an inch when the tangential force is of the order of 28 pounds. This distance is about the same as the stretch of the specimen, and hence $(1-\sin\theta)$ must be considerably greater than heretofore assumed. As a consequence of the larger angle of bend, failure occurs between the plies of the board before tensile failure occurs, and the stiffness of the board decreases to a low value.

In view of the above analysis, it may be said that initial tearing resistance determined by the subject method is largely determined by the stress-strain characteristics of the material under test. Particular attention should be paid to the fact that the angle θ is an important variable $(F_t = F\cos\theta)$. This angle depends upon the ultimate stretch of the material; the larger the ultimate stretch, the smaller will be θ, and, consequently, the larger will be $\cos\theta$. If two samples have the same tensile strength, but appreciably different stretch, the *tangential force* F_t should be greater for the sample having the greater stretch. Thus it would appear that initial tearing resistance as determined by the subject method is largely dependent upon tensile strength and stretch. This is strongly attested to by the data appearing in Fig. 5. Where the tensile strengths are substantially the same, the initial tearing strength is much greater for the cross machine direction than for the machine direction, and, as shown by the data of Table VI, the stretch in the cross machine direction is usually about twice that for the machine direction.

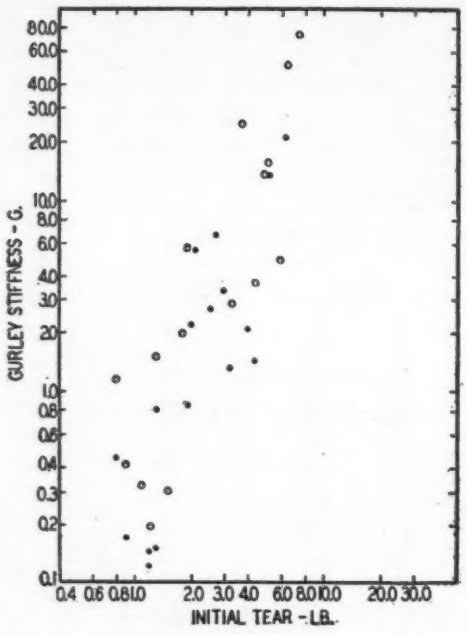


FIG. 7.
Initial Tear vs. Gurley Stiffness
○ Machine Direction ● Cross Direction

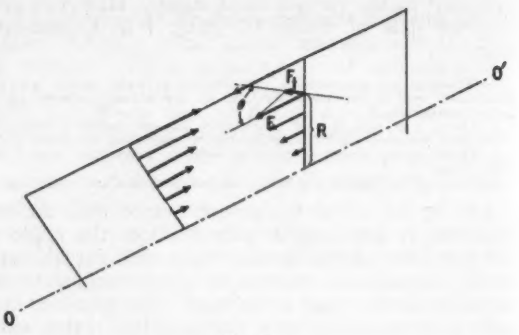


FIG. 8.
Stress Diagram

In view of typical use requirements, the feasibility of a method which yields a value of tearing resistance dependent on stretch is questioned.

There are several changes which would improve the accuracy and increase the scope of application of the Thwing initial tear tester. Some of these are as follows:

1. The adoption of a means of loading at a more uniform rate
2. The calibration of the dial in terms of actual pounds of force exerted on the specimen
3. The installation of a wing-tipped pointer on the dial to reduce error in reading the scale
4. The provision of variable pendulum weights with corresponding dial calibrations to expand the range of the instrument to cover lighter and heavier materials than those covered by the present range
5. The design of supporting members so rigid as to ensure constancy of separation of the two pairs of jaws.

Conclusions

1. The Thwing initial tear tester gives reproducible results.
2. The magnitude of the results, in general, is increased by increasing the width of the specimen.
3. Within reasonable limits, the rate of loading does not appear to have a significant effect on the results.
4. Inconsistent results are obtained by testing several strips simultaneously.
5. Initial tearing strength correlates in a general way with Elmendorf tearing strength and with tensile strength.
6. Initial tearing strength as determined by the subject method is largely dependent upon tensile strength and stretch, the nature of the dependence being such that an increase in tensile strength and/or stretch causes an increase in initial tearing strength.

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(1) Brecht, W., and Imset, O., *Wochbl. Papierfabr.* 64, no. 48:848-853 (Dec. 2, 1933).
(2) Beach, R. L., *Paper Trade J.* 108, no. 5:30-35 (Feb. 2, 1939).
(3) The Institute of Paper Chemistry, *Paper Trade J.* 110, no. 7:29-37 (Feb. 15, 1940).

Carton Men on Outing

[FROM OUR REGULAR CORRESPONDENT]

RUMFORD, R. I., July 21, 1941 With Arthur L. Young, a veteran in the paper box business as a special guest, wonderful weather, and the two purposes of the meeting fulfilled—sociability and an award of a prize for almost every golfer, the annual outing of the Carton Association, Providence, R. I., held at the Wannamoisett Country Club, in this town, July 14, was a grand success.

Approximately 60 attended, some coming early in the day for luncheon and golf, while others arrived in the afternoon. Some who did not play golf just rested as "tired business men" in comfortable chairs on the grounds of the club, watching players tee off and chatting more or less in the lighter vein. It was a good time for all.

After the dinner, President Charles K. Shaw (Shaw Paper Box Company) welcomed the guests, who included both box manufacturers and supply men. He noted that one of the outstanding guests, of a high type among box manufacturers, was A. L. Young, who had been 55½ years actively engaged in the industry.

President Shaw presented the following, all of whom spoke very briefly: Vice-president Oscar Carnevale (Hope Paper Box Company); directors Albert Carpenter; Russell Rhodes; Bill Boutelle; "genial" Thomas Casey Greene; Howard Scholes, president, New England Paper Box Association; Harold Fuller, past-president of the National Paper Box Manufacturers Association, who called attention to another past-president, "Charlie" Shaw; John Munro, of Munro & Church, Boston, secretary of the Carton Credit Bureau of Boston, who invited all members of the Carton Association to come to the outing of his organization which would be about September 10.

Hudson Building Sold

ALBANY, N. Y., July 21, 1941 —Announcement is made of the sale of the building of the Hudson Valley Paper Co. to Harold J. Magee and Vernon F. Conner, of this city, at a price said to be $7,000. The structure, wrecked by fire some time ago, is to be remodeled throughout.

THE BEAR FACTS OF A LUMBER CAMP

The Bare Facts are not enough when it comes to making satisfactory felts. Before we design you a felt we need all the details. Give a DRAPER REPRESENTATIVE the whole story of your requirements and we will guarantee satisfactory results.

Draper Representatives are anxious and able to cooperate with you in the design and production of the felts best suited to your purposes.

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DRAPER BROTHERS COMPANY

Woolen Manufacturers Since 1856 CANTON, MASS.

OUR REPRESENTATIVES to serve you
L. H. BREYFOGLE Kalamazoo, Mich.
C. K. BEECHER Delaware, Ohio
W. L. CAMPBELL Savannah, Ga.
RALPH E. BRIGGS Canton, Mass.
O. J. LELOFF Vancouver, Wash.

CONSTRUCTION NEWS

Brooklyn, N. Y.—Joseph Rubin & Sons, 35 Meserole street, manufacturers of folding paper boxes and containers, have arranged for lease of four-story industrial building on local site at 649 Morgan avenue, totaling about 47,000 square feet of floor space, and will occupy for expansion, including facilities for increased storage and distribution. Company will take immediate possession for installation of equipment as soon as improvements are made.

Los Angeles, Calif.—The Zellerbach Paper Company, 3000 East 12th street, manufacturer of paper products for commercial and other service, has approved plans for addition to local plant, to be one-story, 182 x 221 feet. It will be used for expansion in storage and distribution department. No estimate of cost announced. General erection contract has been let to the Austin Company of California, Inc., 777 East Washington boulevard, and work will begin at early date.

Tacoma, Wash.—The St. Regis Kraft Company has work under way on addition to local mill on Canal street, recently referred to in these columns, and will push erection to early completion. It will be one-story, equipped as a recovery unit, and is estimated to cost in excess of $75,000, including equipment. The Howard S. Wright Company, Seattle, Wash., has the general erection contract. Company also is making other improvements and extensions in mill, in connection with an expansion and improvement program, authorized a few months ago.

Chicago, Ill.—Horder's, Inc., 231 South Jefferson street, manufacturer of paper specialties, stationery supplies, etc., has arranged for lease of additional space in building at location noted, known as the Jefferson-Quincy Building, totaling about 16,000 square feet of floor space, and will use for expansion in converting department, including paper products of various kinds, carbon papers and other products, with part of space to be used for storage and distribution. Company will take possession at once and install equipment.

Seymour, Conn.—The Pond's Extract Company, Seymour, manufacturer of facial tissue stocks, etc., has completed plans for two new additions to mill, consisting of a one-story structure, 80 x 125 feet, to be used for pulp storage service, and one-story, 80 x 200 feet, designed for paper storage and distribution. Cost estimated over $65,000, with equipment. General erection contract has been let to the H. Wales Lines Company, 134 State street, Meriden, Conn., and work is scheduled to be placed under way at once. An award for installation of an automatic sprinkler system has been made to the Grinnell Company, Inc., Providence, R. I.

Wisconsin Rapids, Wis.—The Consolidated Water Power and Paper Company, Wisconsin Rapids, manufacturer of book papers, writing papers and kindred stocks, has construction in progress on new one-story addition to mill, about 72 x 86 feet, for storage and distribution service, and will have structure ready for occupancy at early date. Work is being carried out by company forces, as previously mentioned in those columns, and a number of miscellaneous contracts have been let for structural steel framing, steel sash, overhead doors and other materials. A crane and other handling facilities will be installed. No estimate of cost announced. Thomas Utegaard is company engineer, in charge.

Parchment, Mich.—The Kalamazoo Vegetable Parchment Company, manufacturer of waxed and other processed paper stocks, wrapping and bond papers, etc., has approved plans for new addition to mill, forming an extension to present Mill No. 2, to be one-story, about 100 x 350 feet, to be used for expansion in production department, with part of space given over to storage and distributing division. Completion is scheduled in about 6 months, including equipment installation. Cost reported over $100,000, with machinery.

Meridian, Miss.—The Flintkote Company is operating on a maximum capacity schedule at local wood fiber insulation board mill, giving employment to a full working force in all departments. Orders on hand insure continuance of this basis for many months to come. Company also is running full in mills at other points used for paper board manufacture. Main offices are at 30 Rockefeller Plaza, New York, N. Y. As recenaly noted in these columns, company has arranged fund of $1,260,000 through financing for expansion and general operations at mills throughout the country.

Cleveland, Ohio—The Hinde & Dauch Paper Company, Inc., Sandusky, Ohio, manufacturer of corrugated paper boxes and containers, is awarding miscellaneous finishing contracts for new one and two-story addition to branch plant at 2110 West 110th street, Cleveland, previously referred to in these columns, including painting, plastering, heating installation, etc. New unit will be about 150 x 383 feet, and will be used for general production, storage and distribution. It will represent an investment of close to $130,000, with equipment. Structure is scheduled for completion at early date. The Albert F. Higley Company, 2036 East 22nd street, Cleveland, has the general erection contract.

New Companies

Astoria, New York, N. Y.—The Astoria Paper Stock Company, Inc., Astoria, Queens Borough, has been organized with capital of 200 shares of stock, no par value, to deal in paper goods of various kinds. New company is represented by Carl A. Kahn, 50 Court street, Brooklyn, attorney.

New York, N. Y.—The Spring Paper Stock and Waste, Inc., has been incorporated with capital of $10,000, to deal in waste paper stocks. New company is represented by Schwartz Brothers, 2 Lafayette street, New York, attorneys.

Providence, R. I.—The Industrial Paper Tube Company, 24 Tell street, has filed notice of organization to deal in paper tubing and kindred paper stocks. Michael J. D'Ambra is head.

Paper Demand at Peak

[FROM OUR REGULAR CORRESPONDENT]

INDIANAPOLIS, Ind., July 21, 1941—Judging from the activity in paper demand during the past two months, the current summer likely will be one of the best in the trade's history. Demand is far ahead of the same time a year ago and does not seem confined to any particular item. The entire list is active and there is much conjecture now about the price situation in the future. Prices, naturally, are strong and the general level is above that of a year ago. Demand now seems to be spread over a wide range of consumers. Stocks in consumer hands are larger now than they have been during many months, with the exception of some items, which are becoming increasingly difficult to acquire.

Fine paper demand continues very active with all items in the list sharing in the popularity. The larger printing establishments in Central Indiana are working steadily and report a lot of work in prospect. They are considerably concerned about price levels and many of them are buying against future demand.

Building papers continue to hold the edge in volume. Construction in this entire area has been much higher than a year ago and from all present indications local construction, including the city proper and the suburban areas, will be the largest it has been in history. All grades of building paper and roofing are in demand and in some quarters there are reports of increasing difficulty in securing deliveries. Prices have shown a gradual upward trend.

Advertising lineage continues to mount in this section and the result has been a steady demand for newsprint. Summer specialties are moving well and waxed papers, glassines and cellophane all are showing satisfactory increases over the volume a year ago.

Last week saw an increase in mill demand for rags, with all quotations firm to strong and all grades of rags apparently sharing in the demand. Demand for paper stock, while good, was not as heavy comparatively as that for rags. Prices however were firm.

TRADE AUTOMATIC MARK

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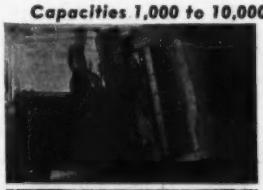
FOR ECONOMICAL MATERIALS HANDLING

- LOW AND HIGH LIFT TRUCKS
- FORK TRUCKS
- PULP AND BALE HANDLERS
- PAPER ROLL HANDLERS
- LOAD CARRIERS
- TRACTORS — CRANES

Capacities 1,000 to 10,000 Lbs.



☆ Center-Control 3000 to 6000 lb. capacity motorized revolving paper roll handlers.

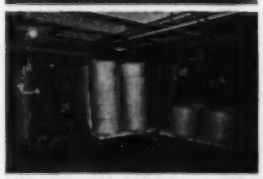
Heavy-duty, center-control fork trucks—telescopic tilting, tiering type for low-cost roll storage and transportation. Capacities 3000 to 6000 lbs.

☆ Center-Control 6000 to 7000 lb. capacity heavy-duty, motorized revolving paper roll handlers.

☆ Box-car bale and roll unloader for single tier storage. 1500 to 2500 lbs.

☆ Box-cars can be loaded and unloaded in record time — with motorized roll upender. Capacities up to 3000 lbs.

☆ Chisel type pulp handlers for box-car loading, unloading and stacking.



☆ 6000 lb. capacity low-lift and high-lift trucks for skid transportation of small rolls and flat stock.

Listed Under Reexamination Service of UNDERWRITERS' LABORATORIES

AUTOMATIC TRANSPORTATION CO.

78 W. 87th St. Div. of the Yale & Towne Mfg. Co. CHICAGO, ILL.

Mutual Paper Co. Moves

The Mutual Paper Company, Inc., has removed its main office and warehouse to 510-14 West 27th street, New York. The company has invited its customers and friends to an "Open House" to be held at the new location on Saturday, July 26.

Roofing Paper Output Up

[FROM OUR REGULAR CORRESPONDENT]

TORONTO, Ont., July 21, 1941—Sixteen establishments in Canada were engaged wholly or chiefly in the manufacture of roofing papers in 1940, according to the dominion bureau of statistics, as reported July 14. These manufacturers produced goods valued at $8,775,352. In 1939, fifteen manufacturers produced roofing materials valued at $7,194,276.

In 1940 the plants were distributed as follows: Quebec, five; Ontario, four; British Columbia, three; Manitoba, two; and New Brunswick and Alberta, one each. The plants gave employment to 991 persons in 1940, compared with 868 in the previous year.

PAPER TRADE JOURNAL

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Henry J. Berger

EDITOR

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COMING EVENTS IN PAPER INDUSTRY

New England Section. Technical Association of the Pulp and Paper Industry—Third Friday of each month at the Roger Smith Hotel, Holyoke, Mass.

Delaware Valley Section. Technical Association of the Pulp and Paper Industry—First Friday of each month at the Engineers Club, Philadelphia, Pa.

Lake States Section. Technical Association of the Pulp and Paper Industry—Second Tuesday of each month at the Conway Hotel, Appleton, Wis.

Kalamazoo Valley Section. Technical Association of the Pulp and Paper Industry—First Thursday of each month at the Park, American Hotel, Kalamazoo, Mich.

Technical Association of the Pulp and Paper Industry, Fall Meeting, Ann Arbor, Mich., September 16-19.

National Paper Trade Association, annual Fall Meeting, Stevens Hotel, Chicago, Ill. September 15-17.

TAXES

In view of the wide public discussion of taxes the subject becomes of increasing importance as the preparation of the new 1941 tax bill nears completion. According to current reports it is unlikely that the Ways and Means Committee will have finished its work this month. Many contemplate the introduction of the new tax bill with concern. More confidence that the worst inequalities in the new measure will be at least modified, would be felt if Congress was more disposed to make savings in non-defense expenditures to relieve taxpayers of some of the heavy burden which they must bear. As the President has requested that new construction work be limited to projects of importance to national defense, it is to be hoped that Congress will more closely watch spending for all purposes not essential for defense needs.

In a discussion on "Who Pays the Taxes" . . . The Tax Foundation, 30 Rockefeller Plaza, New York, in its current issue of *The Tax Review*, analyzes the study made by the Temporary National Economic Committee, known as Monograph No. 3, stating that, "Inasmuch as its conclusions may form the basis for new Federal tax policies, it is vital that the assumptions upon which the conclusions rest be examined most carefully. The thesis of Monograph No. 3 was that effective tax rates were higher on incomes under $1,000 than on incomes between $1,000 and $10,000, and it showed in some of its tables that taxes were relatively higher on incomes under $500 than on incomes between $500 and $15,000. It stated that 'the total American tax pattern is regressive at its lower end, nearly proportionate through all the middle brackets from $1,000 to $5,000, and increasingly progressive from there on'. It also stated that 44.4% of all taxes were paid by persons with income under $2,000. Consequently a number of commentators have concluded that taxes on the classes from $2,000 to $10,000 should be increased Some steps were taken in that direction in 1940, and further steps are now proposed."

Taking up the basic assumption the analysis goes on to state that "The monograph stated that it was based on certain assumptions; it should be regarded as a 'scouting expedition into unmapped territory', presenting 'merely reasonable estimates', or 'constructional statistics'. It is in fact a complicated construction of statistics based on the National Resources Committee's reports on consumer income and consumer expenditures, which in turn were based on small samples, refined and extrapolated to a dangerous degree . . . The first assumption was that all taxes, except individual income taxes, corporate income and profits taxes, poll taxes, estate and gift taxes, and part of the personal property taxes, were passed on to consumers. In other words, it assumed a forward shifting of all taxes on business (except those based on net income), including taxes on farm property, residential property, custom duties, and the employers' share of the Social Security payments. It mentioned that some business taxes may fall on profits, but neglected entirely the possibility that some may fall on salaries. It discussed the possibility that taxes on land and buildings may be capitalized, but made no allowance for the possible incidence of such taxes on owners of real estate, except owner-tenants."

Discussing the incidence of business taxes the article states that, "With regard to the genuine taxes, the assumption that all business taxes are passed on to consumers would appear to represent an extreme point of view. There is room here for considerable difference of opinion. It is believed that most students of tax-shifting would agree that taxes on payrolls (such as the employer's share of old-age insurance and unemployment compensation) are more likely to fall on the employer or the employee; and taxes on real property used in business more likely to fall on profits or on the property-owner or to be capitalized, especially taxes on farm land (which are treated as business taxes in the monograph). Other business taxes, such as those imposed on gross sales or on inventories, might be passed on to consumers, absorbed by business, passed back to employees, or passed back to suppliers, especially farms and miners. Even special consumption taxes may be absorbed by business or passed back to suppliers."

Referring to the relief factor, the article states in part that, "Of the 6,211,000 consumer units reported by the National Resources Committee as having incomes under $500 in 1936-37 between 1,804,000 and

2,454,000, or between 29% and 39% were on relief. Is it proper to assume that persons on relief bear the burden of taxes on the goods that are supplied to them at the public expense, or even on the goods that they buy with money given to them and not earned? Another 1,090,000 (17%) were farming families, who obtained a large part of their food and fuel free from tax. Farmers, incidentally were not required to make Social Security payments . . . In the light of these considerations, the estimate of taxes on consumption paid by units with incomes under $500 might easily be considerably less than shown in these tables."

In conclusion the analysis states that, "assuming the correctness of the National Resources Committee's estimates concerning the distribution of income and consumers' expenditures in 1935-36, the estimates of the monograph concerning the ratio of taxes to income in 1938-39 require considerable modification. If the National Resources Committee estimates are inaccurate, as some critics have suggested, these estimates would require even more modification. The ratio for the classes below $5,000 appears to be overestimated, especially on classes below $2,000. The ratio for the class between $5,000 and $10,000 is underestimated. The monograph estimates for the ratio of taxes in 1940 are apparently high for classes below $1,500 and too low for classes above $5,000, especially the $5,000-$10,000 class and the class above $20,000."

Dr. Minor Goes With Hurlbut Paper Co.

Edward A. Sitzer, president of Hurlbut Paper Company at South Lee, Mass., announces that Dr. Jessie E. Minor, widely known as a consultant in paper chemistry, is now in charge of the laboratory at the Hurlbut Mill. Dr. Minor will devote all her time to the Hurlbut Paper Company, having given up her office in Springfield and moved her complete laboratory equipment to the mill at South Lee. Her experience in paper chemistry will be of great value to the Hurlbut Paper Company, whose products are highly specialized to meet the exacting requirements of present day industry.

Dr. Minor is a graduate of Drury College in Springfield, Missouri, and holds a Ph.D. in chemistry from Bryn Mawr College. For three years, she held a fellowship in chemistry at the University of Pennsylvania, and, for eight years, she was professor of chemistry at Drury College, Goucher College and the Mount Holyoke Daughter College in South Africa.

Long associated with paper manufacturing. Dr. Minor was, for a time, connected with the Hammersley Manufacturing Company of Garfield, New Jersey, and the Collins Manufacturing Company of North Wilbraham, Massachusetts. She also served as pulp and paper consultant with the Emerson Laboratory in Springfield. Later, with the Writing Paper Manufacturers Association, she was engaged in research work on fundamental paper qualities and paper permanence.

Production Ratio Report*

(Production as per cent of six-day capacity)

COMPARATIVE WEEKLY SUMMARIES

Current Weeks, 1941		Corresponding Weeks, 1940	
June 7	97.1	June 8	91.3
June 14	99.3	June 15	91.9
June 21	99.7	June 22	93.1
June 28	101.3	June 29	92.0
July 5 (Holiday Week)	75.0	July 6	69.0
July 12 (Prelim.)	*95.8*	July 13	91.1

COMPARATIVE MONTHLY SUMMARIES

Year	Jan.	Feb.	Mar.	Apr.	May	June	July
1940	89.1	84.7	82.3	84.3	90.0	92.1	85.3
1941	85.6	89.4	92.3	96.4	98.9	*99.6*	...

Year	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1940	85.1	81.5	85.5	84.9	80.9	85.6
1941	...	...	...	...	...	...

COMPARATIVE YEARLY SUMMARIES

	1935	1936	1937	1938	1939	1940	1941
Year to Date..	68.1	77.7	88.0	67.4	78.6	86.7	*92.8*
Year Average..	69.9	80.4	79.8	71.5	83.4	85.6	...

* Based on tonnage reported to American Paper and Pulp Association. Does not include mills reporting to National Paperboard Association, except in isolated cases where both paper and paperboard are produced and separate tonnage figures are not readily available. Does not include mills producing newsprint exclusively.

PAPERBOARD OPERATING RATIOS †

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year Avg.
1936	62	67	67	70	69	70	69	75	78	82	80	74	72
1937	80	86	86	88	85	77	66	74	69	65	55	45	73
1938	54	60	61	57	58	56	57	66	66	70	65	59	61
1939	60	67	71	69	64	67	63	72	74	84	81	71	70
1940	71	70	69	70	76	79	72	74	72	79	77	71	73
1941	75	81	82	83	84	*88*	..	..	..	..	..	..	..

Week ending June 7, 1941—84
Week ending June 14, 1941—88
Week ending June 21, 1941—88
Week ending June 28, 1941—90
Week ending July 5, 1941—74
Week ending July 12, 1941—77

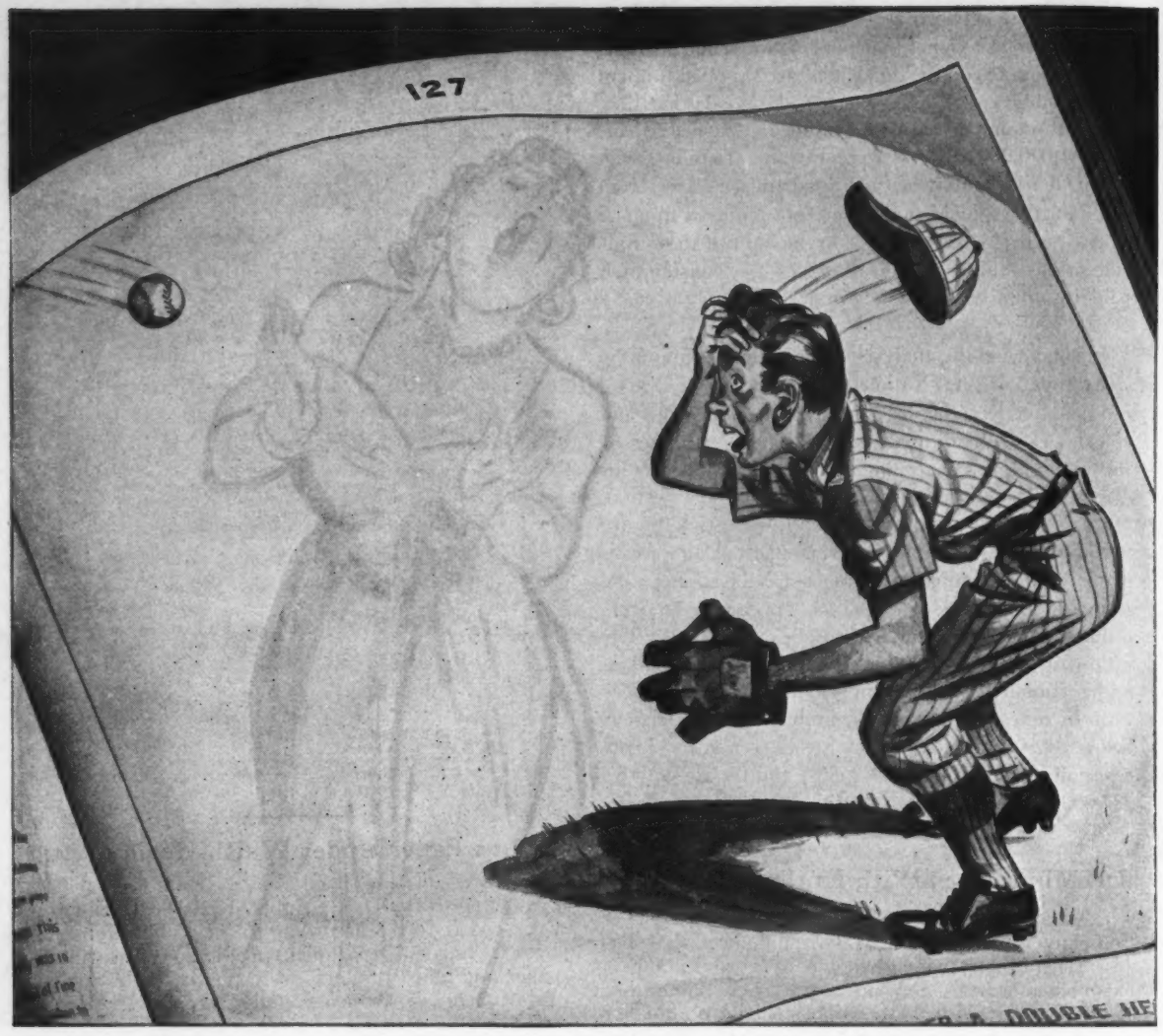
† Per cents of operation based on "Inch-Hours" reported to the National Paperboard Assn.

Buys Paper Under Walsh-Healey Act

[FROM OUR REGULAR CORRESPONDENT]

WASHINGTON, D. C., July 23, 1941—During the week ended July 5 according to the Public Contracts Board, Labor Department, $381,126.01 worth of paper and allied products were purchased by various government departments under the Walsh-Healey Act.

Purchases were as follows; Walker-Goulard-Plehn Company, $16,000 worth of printing paper for War Air Corps; Chatfield Paper Company, $14,400 worth of printing paper for War Air Corps; Marquette Paper Company, $27,880.00 worth of printing paper for War Air Corps; Whitaker Paper Company, $57,400.00 worth of printing paper for the War Air Corps; Paper Corporation of U. S., $18,575.20 worth of wrapping paper for War, QMC, Jersey City, N. J.; Equitable Paper Bag Company, Inc., $11,953.55 worth of paper bags for War QMC, Jersey City; Graham Paper Company, $43,586.17 worth of paper bags for War QMC, Jersey City; W. L. Jones, Inc., $65,949.31 worth of wrapping paper, War QMC, Jersey City; Union Bag and Paper Corporation, $20,102.14 worth of paper bags, War QMC, Jersey City; Kimberly-Clark Corporation, $20,270.00 worth of wrapping paper for War Air Corps; Walker-Goulard-Plehn Company, Inc., $12,750.00 worth of wrapping paper for War Air Corps; L. Hyman & Sons, Inc., $12,060.00 worth of memo. pads for War QMC, Ind.; Bonestall & Co., $13,376.19 worth of mimeograph paper for War QMC, Cal.; Eastern Corporation, $15,617.00 worth of writing paper for GPO; and Globe Wernicke Company, $31,206.45 worth of guide cards for War Air Corps.



"*MI-MI-MI-MI-MI-MI-MI-MI!*"

...screamed the soprano on page 128 to the outfielder on page 127

"How about ME?" roared the outfielder. "You made me miss that fly ball, you . . . hyena!"

"HYENA!" screamed the soprano. "He calls me a hyena! I who have seeng at ze Metropolitan . . . La Scala . . ."

"O.K., sister," sighed the fielder. "Forget what I said. But please take your mi-mi's somewheres else."

"Eef I could leave I would go," said the soprano. "But I am ze *show-through!* Only Krebs Peegments keep me on ze right side of ze page."

"Krebs Pigments will strike you out?"

"*Certainment! Zey* take *show-through* out ze theenest papair. And zey make papair so white zat preenting stands out sharp and clear—like my seenging. MI-MI-MI-MI . . .!"

"Now look, lady," interrupted the fielder. "That yodeling ain't helping my fielding any!"

"Eef you need help, ze Krebs experts feex technical peegment problems *beaucoup* eezy!

"I sure do need help," agreed the fielder. "Tell me what to do."

"Write ze letter—*tout de suite!*"

KREBS PIGMENT & COLOR CORP.

1007 Orange Street...Wilmington, Delaware

Section of the
Technical Association of the Pulp and Paper Industry

Edited by Ronald G. Macdonald, Secretary

Performance of Machine Coated Papers and the Scope of their Application*

By G. K. Dickerman[1]

Abstract

The printing performance of papers made and coated in a continuous operation on the paper machine is based on the character of the surface as is the performance of any coated paper. This is controllable to a large extent through the formulation and application of coating. Each type of coater has its own limitations and advantages whether operated with the paper machine or as a separate unit.

Before discussing the performance and scope of application of machine coated papers, let us first examine them as a class to see what they are. By mechanical tests and printing results they are definitely coated papers. Obviously the distinction is not that they are "machine coated" as compared to "hand coated" papers, for coated papers generally are coated by machines. Therefore, if we accept the term "machine coated papers," it must be as a term referring to one detailed method of machine manufacture as against another, and not to the physical qualities of the paper itself. The Dictionary of Paper defines machine coated paper as "paper coated with a mineral pigment on a coating device which is part of the paper machine." In other words, it is a coated paper produced on a coating machine which has been so designed that it may be operated on a continuous web in conjunction with the paper machine.

This method of coating has been made possible through development of new coating machine designs and new conceptions of methods for applying the mineral surface. Limitations inherent in the designs of all types of coaters developed up to a few years ago made them unsuitable for operation integrated with the paper machine. It is obvious that a coater, in order to operate as part of the paper machine, must be built to the full width of the machine. It must operate continuously without interruptions for cleanups or adjustments. The coating must be applied and dried at the operating speed of the paper machine. The brush coater in its present design does not generally meet these requirements, nor do other types of coaters which are successfully operating as separate units. It was not until coaters of entirely new design were conceived that coating on the paper machine became possible.

Range of Coated Papers

The range of coated papers produced on the paper machine shows a striking versatility. At present most of the weights are in the lighter brackets from 40 to 80 pounds with the greatest tonnage between 45 and 60 pounds. All types of raw-stock furnishes can be used. Coatings can be prepared from most of the pigments, clays, and adhesives which have commonly been used in coating papers. Finishes range from a dull surface to a high gloss.

In coating a sheet of paper we have a means of controlling the surface beyond the usual papermaking variables to meet the necessary printing requirements. Important surface characteristics which are controllable to a greater or lesser extent in any coating operation are absorbency, receptivity, smoothness, gloss, pick test, brightness, and surface pH. Control is exercised through coating formulation, coating application and finishing, with the raw stock always playing an important part. Limitations on these controls depend on the flexibility of the process and the requirements of the product. Unfortunately some of the important printing requirements are contradictory in nature and compromises must be worked out to obtain a most favorable balance. Paper can be made poorly or well by this process, as in any papermaking process.

It is evident that many of these papers are designed for special purposes and any generalization on printing quality is apt to be confusing. However, although produced by new methods and on new types of coating machines, they are coated papers and must be considered as such in discussing their performance. That they are performing successfully is self-evident from the substantial volume being used in various fields of printing and publishing.

Scope of Coated Paper Use

The scope of application of coated papers in general has been greatly broadened by the introduction of papers coated on the paper machine. The greatest tonnage thus produced has gone to markets which are new to coated paper and therefore represents a large increase in the amount of coated paper used. This has been due primarily to the ability to produce

* Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Roosevelt Hotel, New York, N. Y., Feb. 17-20, 1941.

[1] Member TAPPI, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.

by this method a large tonnage of coated paper at low cost.

In the publication field, increased competition for the advertising dollar and greater emphasis on pictorial and color reproduction paved the way for drastic changes. Letterpress printing on coated papers has held the lead in quality of printing ever since the invention of the halftone plate, but cost of paper and the slow speed of printing made such a combination prohibitive except for inserts or for selected magazines of comparatively low circulation. Development of heat set inks made possible high speed letterpress printing on a mineral surface. Almost simultaneous introduction of papers coated on the paper machine completed the picture and the last five years have witnessed a remarkable change in the printing and paper requirement of publications in all classifications.

In the mail order catalog field, the introduction of heat set gloss inks made possible high speed, four-color letterpress printing of a new order of clarity and brilliance. To retain the full color value and gloss of these inks, a new type of lightweight coated catalog paper was developed. A high-groundwood content provided the necessary cushion and opacity. Economical application of the correct amount of coating was feasible only by coating on the paper machine. The result was an increase of over 50% in the number of color pages in the catalogs of the four largest American mail order houses, practically all of it on catalog paper coated on the paper machine.

Paper coated on the paper machine and cut into sheets for general letterpress printing is finding a distinct field in catalogs, magazines, and folders where cost of paper is an important consideration, and where good pictorial reproduction is required. When these papers first reached the market, they were below present day standards of smoothness, receptivity, and other important characteristics which go to make up printing quality. They were hard to print, although in most instances satisfactory results were obtained, particularly when compared to uncoated paper. As experience was gained in operating the new coaters, heavier and smoother coatings have become possible. Today papers coated in this manner and of greatly improved printing quality are available. Printers are able to obtain results on most types of jobs which in the past were secured only on coated papers in the higher price brackets, and they are not confined to uncoated papers to meet a close budget.

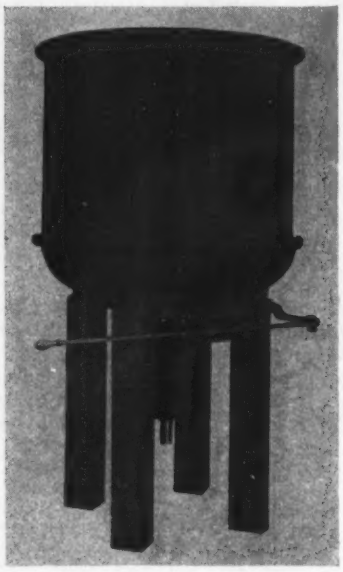
While coating on the paper machine generally has greatly broadened the scope of application of coated papers, there have been limiting factors in the mechanics of operation which must be considered in defining the field. It is essentially a mass-production operation, and consequently the product must be confined to a relatively small number of standardized grades. Losses involved in frequent grade changes would largely nullify potential economies. Full machine trims must be provided. The smaller tailor-made orders should not be considered for this field.

Bearing these qualifications in mind, we should hesitate to define any clear limits on the quality of coated papers which can or will be produced by this new method. We may expect their performance to show further improvement and their scope to further increase the consumption of coated papers. These factors, coupled with important developments in printing processes, will raise materially the general standard of quality in printing.

New Dilts Hydrapulper

Specially designed for applications where a small capacity is needed, Dilts Machine Works, Fulton, N. Y., announce a new Hydrapulper with a 10 ton/24 hour output.

This small Hydrapulper is identical in every respect except size with the giant production units now being built for the nation's paper mills. For mills making molded paper products such as paper flower pots,



New Small Capacity Hydrapulper

plates, and the like it is ideal. For paper specialties it is ideal. For laboratory usage it is ideal.

This 10 ton Hydrapulper has a 150 gallon capacity at operating depth. It is 4 feet in diameter, 10 feet in height. It has the same tremendous pulping appetite that enables many mills to feed entire pulp rolls or uncut bales of mixed papers, wires and all.

Full information including details from actual applications is available on request to Dilts Machine Works, Fulton, N. Y., Division of the Black-Clawson Company.

Index of Paper Mill Inventories

[From our regular correspondent]

Washington, D. C., July 23, 1941—Index of the value of paper mill inventories for May was 109.4 compared with 111.3 in April and 104.9 in May of last year taking December 31, 1938 at 100 according to the monthly industry survey of the Department of Commerce.

In May the index of the value of paper mill shipments was 186 compared with 162 in April and 137 in May of last year taking January 1939 at 100 according to the survey.

The May manufacturers' inventories for all industry recorded the sharpest increase for any month since the end of last year according to the department. In view of the recent substantial price increases it is evident that not all of the gains shown by the value of shipments index is due to actual gains in physical deliveries. Manufacturers' shipments throughout industry in May again responded to continued strong demand.

Status of the Lignin Problem*

By Harold Hibbert[1]

Abstract

The older ideas of Klason that lignin is a coniferyl type (coniferyl alcohol, coniferyl aldehyde, or oxy-coniferyl alcohol) of condensation polymer have received considerable confirmation in the more recent developments in the field of lignin. Principal among these are: (1) the large yield of vanillin (based on the lignin content) from spruce wood (around 25%) and the still higher combined yields of vanillin and syringic aldehyde (around 45%) from maple wood; (2) evidence that spruce lignin is a mixture of condensation polymers formed from simple units containing an aromatic ring having a 3-carbon side chain, which evidence finds support in the isolation of such products as α-hydroxypropiovanillone and vanilloyl methyl ketone; (3) hydrogenation of wood and of extracted lignins to give high yields of cyclohexane derivatives having a 3-carbon side chain, and evidently derived from the above type of unit, present either in relatively simple or more complex form.

The lignin of all softwoods appears to be identical, while that of hardwoods is differentiated only by the presence therein of large amounts of similar derivatives containing the syringyl radical in addition to the guaiacyl radical.

The simple lignin units probably function in the plant as respiratory catalysts and in the postmortal stage undergo polymerization changes to more complex products. The latter do not appear to be highly complex in the plant but due to their marked sensitiveness towards chemical reagents undergo marked alteration in the extraction process. At the moment no process is known by which the proto- (or unchanged) lignin can be extracted without alteration in structure. In wood the carbon side chains appear to consist among others, of several of the following types: (1) R•CO•CHOH•CH₃; (2) R•CO•CO•CH₃; (3) R•CH:CH•CH₂OH; (4) R•CO•CH₂CH₂OH; of which up to the present only 1, 2, and 3 have been identified definitely.

Substances known as 1:2 (or ortho) diketones are present in wood, either as such, or in simple combination. Such products are unstable and readily undergo transformation by alkalis and other reagents into brown or reddish-brown coloring matters which are difficult to remove. They may be responsible for the darkening in color of newsprint on exposure to light as well as for some of the difficulties encountered in the bleaching of pulp.

Extraction of lignin by the alcoholysis of wood (treatment of wood with an alcohol, water, and a reagent such as alkali) appears to hold considerable promise of future technical application while the recent development of processes using only aqueous solutions of organic acids, such as sodium xylene sulphonate, indicates that lignin removal is possible by much milder means than hitherto regarded as possible.

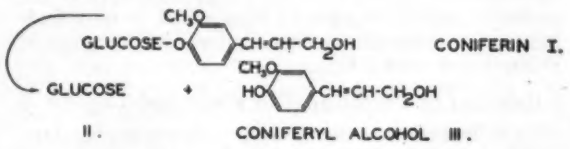
* Presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry, Roosevelt Hotel, New York, N. Y., Feb. 17-20, 1941.

[1] Member TAPPI, Professor of Industrial and Cellulose Chemistry, Pulp and Paper Research Institute, McGill University, Montreal, Que.

There would appear to be *four well-defined phases* in the development of lignin chemistry.

The *first phase* is discernible in the scientific attack on the lignin problem dating back to the work of Klason in 1892 *(1a)*. During this period the new method of making pulp by the sulphite process (patented by Tilgman in 1866) was undergoing rapidly increasing commercial expansion and Klason realized clearly that progress in this new art of delignifying wood would be dependent on extension of the available scientific knowledge of the "wood incrustants" — that is, the products at present grouped under the name of "lignin".

Coniferin[2] (I)[3] was regarded by Czapek *(2a)* as one of the products found in the cambial sap of all young plants. This derivative of glucose (II) and coniferyl alcohol *(2b)* (III) is soluble in water and by repeated alternate extraction of spruce wood meal with slightly acidified water, followed by ethyl alcohol, Klason in 1892 *(1b)* was able to extract from spruce wood meal about 10% by weight of water-soluble sugars (principally xylose, mannose and presumably glucose) and an additional 2% of alcohol-soluble substances, a total of 12% on the dry weight of wood. From the alcoholic extract he isolated two amorphous products, to which, on the basis of his analyses, he assigned the formulas $(C_{10}H_{12}O_3)_2$ and $(C_{10}H_{12}O_4)_2$. The former he regarded as a dimer of coniferyl alcohol (III), no formula being assigned to the latter which he designated as oxy-coniferyl alcohol.



In the following year he showed *(3)* that part of the lignin was dissolved when spruce wood was cooked with methyl alcoholic hydrogen chloride, and this was the forerunner of the more recent important fundamental applications, by Hibbert and co-workers, of ethanolysis to problems of lignin structure.

Klason pointed out *(4)* that condensed coniferyl alcohol possessed many of the properties of lignin. Thus it polymerized readily, was unsaturated and reacted readily with bisulphites to give sulphonic acids in which one part of the sulphur dioxide was attached in labile, the other in stable union. These sulphonic acids were found to possess properties similar to lignin sulphonic acid and to have approximately the same empirical composition. He concluded that lignin was, essentially, a condensation product of coniferyl and oxy-coniferyl alcohols. In a later paper *(5)* he assumed that coniferyl aldehyde (IV) might form the unit of the lignin structure, this opinion being based very largely on comparative analytical

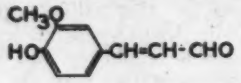
[2] Coniferin was discovered in the cambial sap of larch by Hartig *(Jahrb. f. Foerster, 1, 263 (1861))* designated as such by Kubel *(J. prakt. Chem., 97, 243 (1866))* and shown to be present in a wide variety of young plants, especially conifers.

[3] Roman numerals refer to formulas.

data obtained from the sulphonic acids of lignin and coniferyl aldehyde.

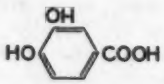
However, according to Freudenberg and Hess *(6)*, most of the phenol groups in lignin are not free, as in the case of the polymeric forms of coniferyl alcohol and aldehyde, but are united through ether-type linkages, thus indicating the incorrectness of Klason's theory with respect to "extracted lignins".

The presence in plant products and wood tars of catechol (V) guaiacol (VI) and protocatechuic acid (VII) also indicated a possible relationship of such phenolic substances to the lignin structure.



CONIFERYL ALDEHYDE IV.

CATECHOL V. GUAIACOL VI.



PROTOCATECHUIC ACID VII.

In the light of Klason's work lignin could be regarded as a polymerized product derived from a building-unit R-C-C-C—(IX c) in which R is the guaiacyl radical—a point of view which is now finding marked confirmation, particularly in the work of Hibbert and co-workers.

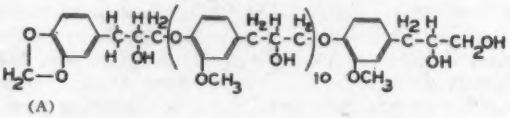
Relation of Protolignin to Extracted Lignins

In a discussion of the lignin problem it is necessary to keep clearly in mind the marked differences now known to exist, as a result of the recent investigations of the author and co-workers, between "protolignin" and "extracted lignins". The term "protolignin" was first suggested by König and Rump *(7)* to denote the "unaltered" lignins present in plant tissues. Whatever the nature of these substances may be, it is now becoming more clearly recognized that they represent products extremely sensitive to the action of chemical reagents such as alkalies and acids, by which they are readily converted into dark, amorphous polymercondensation products *(8)*. Thus conclusions based on the properties of lignins isolated by use of concentrated acids or hot alkalies possess only a limited value and the same is true where hot dilute aqueous mineral acids are used.

The *second phase* of lignin research was concerned largely with attempts to isolate a pure, unchanged lignin from wood by new methods of extraction and to use the products for chemical investigations. The various reagents used included concentrated acids (H_2SO_4, HCl), alkalies, bisulphites, anhydrous alcohols (in presence of anhydrous hydrogen chloride), and oxidizing, nitrating, halogenating, and methylating reagents.

Freudenberg *(9)*, one of the most prolific workers in this period, first used a lignin isolated by the use of concentrated hydrochloric acid (43%) *(10)*, while in his later researches he employed a lignin obtained by alternate extraction of spruce wood meal with cupric ammonium hydroxide and hot dilute sulphuric acid *(11)*. Using the earlier product he showed *(10)* that fusion with alkali yielded traces of catechol (V) *(12)* and protocatechuic acid (5%) (VII), confirming the earlier observations of Heuser and coworker *(13)*.

He also obtained *(14, 15)* small amounts (up to 1.2%) of formaldehyde by the action of hot dilute hydrochloric acid (12%) on "extracted spruce" lignin, and showed that the latter contained methoxyl and secondary alcohol groups, but no *free* phenol groups. In 1933, on the basis of his *analytical data*, he formulated (*9a*, p. 134) *(16)* "primary lignin" as a linear polymer (VIII). Freudenberg's experimental evidence, at this time, of a side chain attached to an aromatic nucleus was restricted to the formation of protocatechuic acid as an oxidation product. The



(A)

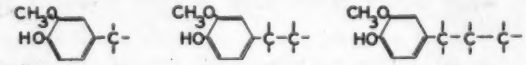
VIII.

formaldehyde was assumed to originate from the terminal piperonyl groups (A) although no piperonyl derivative has, up to the present, been isolated from any lignin.

In addition to the side chain $-CH_2-CHOH-CH_2OH$, other side chains such as $-CHOH-CH_2-CH_2OH$ and $-CHOH-CHOH-CH_3$ were visualized as possibilities. Two new side chains $-CH_2-CHOH-CHO$ and $-CHOH-CO-CH_3$ were also regarded as playing a probable role and the hydroxyl in the end group of one chain (VIII) was assumed to condense with the phenol hydroxyl group in a second chain, thus eliminating the possibility of free phenol groups. The formula (VIII) was not considered entirely satisfactory since it was difficult to postulate transformation of such a product into "secondary lignins" and also the chemical behavior of lignin (action of hydriodic acid, etc.) was not in harmony with such a conception.

Freudenberg therefore assumed that the above linear type of polymers underwent further condensations with one another whereby oxygen bridge rings were formed *(9a*, p. 134).

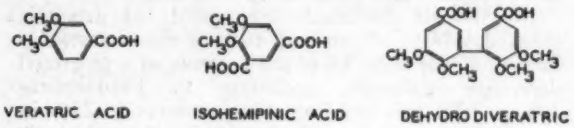
His investigations *(9)* dating from around 1926 have been based, consistently, on the theory that lignin is a condensation polymer (or mixture of polymers) derived from one or more simple "building stones", the latter being closely related, structurally, to Klason's coniferyl- and oxy-coniferyl alcohol or aldehyde; in other words, a polymer (or mixture of polymers) derived from a similar aromatic nucleus having a three-carbon side chain (IXc). Freudenberg's lignin structure (VIII) was based very largely



IX a IX b IX c

on theoretical considerations and it is only quite recently that conclusive evidence of its essentially aromatic character has been supplied by his investigations, those of Harris and Adkins, and, especially, by those of Hibbert and co-workers.

In his later investigations, using cuproxam lignin *(11)*, Freudenberg carried out an extensive series of investigations dealing with methylation studies on lignin and subsequent oxidation of the methylated products *(17)*. In this way he was able to isolate veratric acid (X), isohemipinic acid (XI), and dehydrodiveratric acid (XII) in yields of 10-14%, 2-4%, and 3%, respectively.

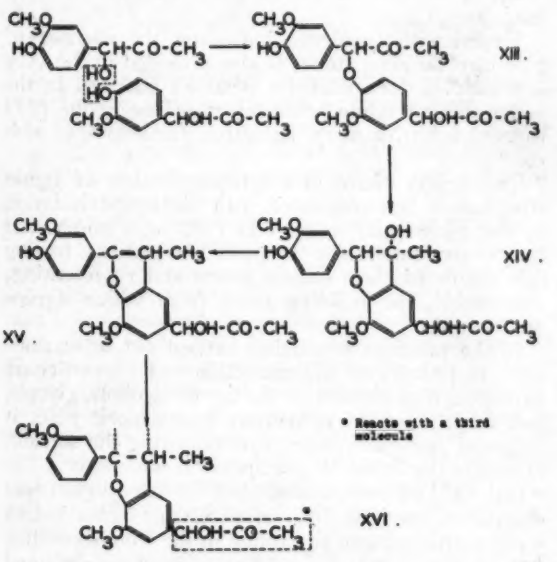


VERATRIC ACID — ISOHEMIPINIC ACID — DEHYDRO DIVERATRIC ACID

10 - 14 % — 2 - 4 % — 3 %

X. — XI — XII.

Based on these and other studies he concluded that lignin is formed as a result of a preliminary condensation between the side chain of one molecule ("building-stone") and the aromatic nucleus of a second, three of the numerous side chains postulated by him being (a) -CHOH-CHOH-CH_2OH; (b) -CH_2-CHOH-CHO and (c) -CHOH-CO-CH_3. These and others are regarded as "biochemical equivalents" and "identical from the biochemical standpoint" *(18)*, which expressions, however, have no scientific significance in biochemistry. An example of the Freudenberg scheme of polymerization, involving the side chain (c) -CHOH-CO-CH_3 of a building stone, is that given below:



MECHANISM OF LIGNIN FORMATION—FREUDENBERG

Two molecules combine, with loss of a molecule of water, to form a dimer (XIII) which can then condense further in similar manner. It is also possible for oxygen bridge formation to take place, intramolecularly, to give XIV. The latter, by further loss of a molecule of water, could yield a benzofurane type of dimer XV, which could polymerize further to give, not only a linear type of polymer, but also one characterized by cross linkages (XVI).

The piperonyl nuclei are now assumed by Freudenberg *(19)* to be intermediate members within the chain and not *end* groups.

It should be pointed out that he has never succeeded in isolating any lignin derivative containing a three, or even a two carbon side chain, with the possible exception of veratroyl formic acid *(17a)* and which lacks confirmation. Furthermore, the type of *primary* condensation between a hydroxyl group of a side chain of one molecule and the phenol group of a second similar molecule is a somewhat unusual mode of reaction.

Since it was the author's belief that methods in use prior to 1926 for the extraction of lignin were far too drastic, and that much milder methods should be employed (a belief amply justified by the results of later investigations), in 1926 Hibbert and co-workers *(20)* (following the initial investigations of Klason *(20b)*, Friedrich and Diwald *(20i)*, and Hägglund and Rosenquist *(20j)*, commenced an extensive series of researches on the structure of spruce lignin obtained by alcoholysis of spruce wood meal with various anhydrous alcohols containing small amounts of hydrochloric acid. Oxidation, halogenation, nitration, and methylation studies *(20a-g, 23)* were carried out on various isolated lignins, such as methanol-, glycol-, glycerol-, chlorhydrin lignin, etc., attention being concentrated mainly on the first-named product, methanol lignin. The primary problem was that of obtaining a *homogeneous* product and sufficient progress was made to warrant the belief at that time that a uniform methanol lignin had been isolated, to which, on the basis of experimental work, carried out largely with the help of F. Brauns, the structure $C_{42}H_{32}O_6(OCH_3)_5(OH)_5$ was given *(21)*. Shortly thereafter it was found the product was a mixture of substances *(22)* so that, while the formula is of interest as representing an average relationship between the several groupings, it cannot be used for the purpose of representing structural and other changes. It was proven clearly, however, that in such alcoholysis reactions the alkyl radical of the alcohol is introduced into the lignin, thus confirming the earlier work of Hägglund *(20j)*.

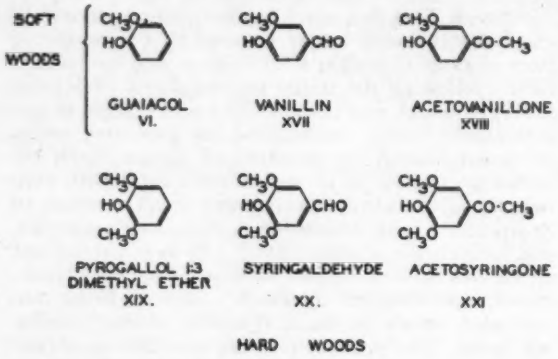
In spite of the efforts of many co-workers *(23)* and the accumulation of valuable new data regarding the nature of constituent groups and linkages, no new fission product could be isolated.

The *third phase* in the elucidation of the structure of lignin may be regarded as that associated with the contributions of Hibbert and co-workers on the action of alkalies on lignin sulphonic acids.

It was known that vanillin had been isolated by the action of alkalies on sulphite waste liquor, first by Grafe *(24a)*, then by Kürschner *(24b)*, Pauly and Feuerstein *(24c)*, and Hönig and Ruziczka *(24d)*, but as the yields were very small this product was not regarded by Freudenberg as an important feature of the lignin structure, especially since its origin from a true lignin product was somewhat uncertain.

In 1932 a study was commenced on the action of alkalies on isolated, carefully purified, spruce lignin sulphonic acid. Vanillin (XVII) was obtained in a yield of 6-7%, based on the weight of Klason lignin present *(25)* and these results, later confirmed by Hägglund and co-workers *(26)*, proved that the

guaiacyl nucleus is an important part of the lignin structure[4]. Shortly thereafter small quantities of acetovanillone (XVIII) *(28a)* and guaiacol (VI) *(27, 28c)* were isolated, along with the vanillin. Application of these new methods to maple lignin sulphonic acid led to the isolation, in 1937, of pyrogallol 1:3-dimethyl ether (XIX) *(29)*, syringaldehyde (XX) *(29)*, and acetosyringone (XXI) *(28c)* in addition to the above-mentioned products (XVII), (XVIII), and (VI), thus indicating a marked difference in the structure of lignin present in soft- and hardwoods, respectively. The isolation of acetovanillone (XVIII) and of acetosyringone (XXI) established definitely, for the first time, the existence of *two-carbon side chains* (IXc, XVIII, XXI) in at least some of the spruce and maple lignin building units.



The probable presence of higher methylated products in hardwoods had been pointed out previously by Wacek *(30)* on the basis of his analyses of beechwood and beechwood lignin and later Freudenberg *(31)* isolated traces of syringic acid from the same source. As a result of the numerous researches carried out by Hibbert and co-workers in the past five years *(32)*, it has now been definitely established that the presence of *both* guaiacyl and syringyl types is a characteristic property of hardwoods as compared with softwoods, and apparently serves as a distinct differentiating feature (as between angiosperms and gymnosperms). It is likewise known that syringin (the analog of coniferin) is also present in a number of hardwoods *(33)* but as yet has never been found in any softwoods. The exact proportions in which these nuclei exist in the various woods still remain unknown.

The yield of vanillin from sulphite waste liquor by the action of alkali on spruce lignin sulphonic acid in presence of *m*-nitrobenzene sulphonic acid was found *(34a)* to be somewhat higher than in absence of the latter reagent, although in both cases the yield was very small (3.6 and 1.0%, respectively). Recently Freudenberg *(34b)*, using this same procedure on spruce wood and employing much larger amounts of nitrobenzene, was able to obtain a yield of vanillin amounting to approximately 25%, based on the weight of lignin. This has been confirmed in these laboratories *(32g)*. More recently by the action of the same reagents on maple wood, a mixture of vanillic and syringic aldehydes has been isolated by us in a yield of around 40-45% *(32g)*, calculated on the Klason lignin present, thus proving beyond doubt that at least 40-50% of the Klason lignin of maple wood is of an aromatic ring type and providing definite and conclusive evidence of the untenability of recent claims by Hilpert *(35)* that lignin possesses a carbohydrate and not an aromatic structure. These findings thus confirm similar conclusions drawn by Freudenberg from his earlier methylation studies on cuproxam lignin referred to above *(17)*. Such high yields of simple molecular aromatic fission products would seem to indicate very marked future commercial possibilities for a new organic chemical industry based on wood, lignin, and sulphite waste liquor as raw materials.

In view of the above high yields of aromatic aldehydes it is of interest that in these cases no indication was obtained of the presence of a piperonyl derivative although, according to Freudenberg *(9b*, p. 109) this building stone amounts to 25% in spruce lignin. The small amount of formaldehyde liberated by the action of hot aqueous dilute acids on spruce and other extracted lignins can be regarded as originating from (a) the presence of a small amount of carbohydrate material *(36)*; or (b) one or other of the three-carbon side chains attached to the benzene nucleus. In the latter category there are theoretically several of special interest, namely, acyl carbinols ($R—CH_2—COCH_2OH$), aryl vinyl ketones ($R—CO—CH=CH_2$), and unsaturated alcohols ($R—CH=CH—CH_2OH$), types of which are to be found in Fig. 2 (VII, XIII, and XV, respectively). Such products are very reactive and in presence of mild reagents (in some cases merely on standing in air) decompose to give formaldehyde *(37)*. Freudenberg's recent claim that his new analytical procedure *(17c)* permits of a sharp differentiation between formaldehyde liberated from piperonyl derivatives and that from other products seems somewhat doubtful in view of the drastic conditions used by him.

Experimental evidence indicating the absence of piperonyl building stones is also provided in the very low yield of formaldehyde (0.03%) obtained in the action of hot dilute acids on sassafras lignin *(38)* isolated from *Sassafras sassafras*, the source of safrol.

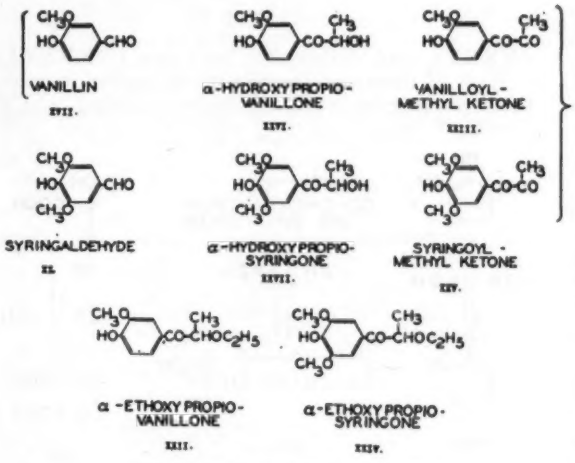
The *fourth phase* in the determination of lignin structure is that concerned with the recent isolation by the author and co-workers *(40)* of a number of simple monomolecular aromatic derivatives having side chains of *three* carbon atoms and representing, presumably, the building units from which lignins are derived.

In the previous researches carried out by various workers *(20a-g)* on the extraction and properties of various lignins isolated by the use of alcohols, glycols, etc., in presence of anhydrous hydrochloric acid, it had been customary, after first removing the solvent, to isolate the lignin by precipitation into water. The actual yield of brown, amorphous isolated lignin was invariably low (30-60% on a Klason lignin basis) a substantial amount remaining in the woody residue. It was evident that a considerable fraction remained in the aqueous solution, and that up to that time no attempt had been made to investigate the nature of these water-soluble products. Thus when maple wood meal, previously extracted to remove fats, waxes, resins, and tannins, is refluxed with ethyl alcohol and hydrochloric acid for 48 hours,

[4] Based on this study an industrial process for the manufacture of vanillin from sulphite waste liquor has been developed (Hibbert and Tomlinson, U. S. patent 2,069,185, Jan. 26, 1937) and put into successful operation by the Howard Smith Paper Mills Limited.

about 60% of the lignin (Klason basis) is dissolved *(39)*. Examination of the alcoholic extract indicated the presence, in addition to the brown amorphous ethanol lignin *(40)*, of a considerable amount (30%), based on Klason lignin, of crude water-soluble, methoxyl-containing, aromatic substances, the identity of a substantial amount of which has already been established.

These consist of α-ethoxypropiovanillone (XXII) *(40a)*; vanilloyl methyl ketone (XXIII) *(40b)*; syringaldehyde (XX) *(40c)*; α-ethoxypropiosyringone (XXIV) *(40d)*; syringoyl methyl ketone (XXV) *(40e)*; and a neutral, nonaromatic diketone fraction *(40f)*. It is assumed that (XXII) and (XXIV) are formed during ethanolysis from the corresponding derivatives, namely, α-ethoxypropiovanillone (XXVI) and α-hydroxypropiosyringone (XXVII).



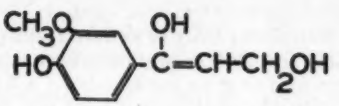
ETHANOLYSIS PRODUCTS OF WOOD

In addition to the above derivatives it seems probable that two additional products, oxy-coniferyl alcohol (XXVIII) and oxy-syringyl alcohol (XXIX) may be present, although their satisfactory isolation and identity still await completion of investigations now in progress.

What is the significance of these new products? In the first place they are all C_6-C-C-C-(IXc) units —that is, they consist of a three carbon side chain attached to a benzene ring and are, presumably, the true lignin progenitors. Some of them, when boiled with dilute acids, yield brown amorphous lignin-like products and are converted by alkalies into reddish-brown condensation products of unknown composition. It is highly probable that they are related to Klason's original lignin building units, namely coniferyl alcohol and coniferyl aldehyde. In addition they are all derivatives of phenyl propane (XXX) and related to the various types, postulated, on theoretical grounds, by Freudenberg *(15, 16)*.

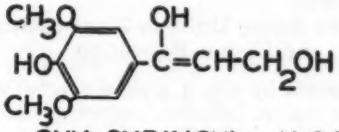
Some years ago Phillips *(41)* isolated 1-n-propyl-3-methoxy-4-hydroxybenzene in very small yield (less than 0.1%) from the distillate obtained by heating alkali corn-cob lignin with zinc dust. Inasmuch as the cobs had not been previously extracted to remove resins, fats, waxes, and tannins, the true origin of this product was uncertain.

The isolation and identity with synthetic products



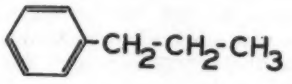
OXY-CONIFERYL ALCOHOL

XXVIII.



OXY-SYRINGYL ALCOHOL

XXIX.



PHENYL PROPANE

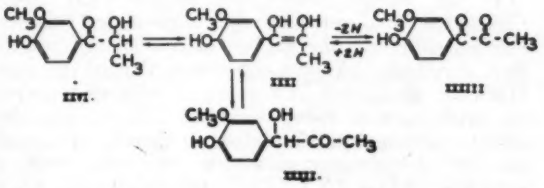
XXX.

of the above ethanolysis derivatives from maple and spruce wood, respectively, leave no doubt they are true lignin components and thus provide proof of the presence of C_6-C-C-C-(IXc) building units in lignin.

Also, theoretical speculations, from a biological oxidation viewpoint, would appear to indicate not only a close chemical relationship among the above simple molecular products but also one with respect to their role in lignin formation.

The products α-hydroxypropiovanillone (XXVI) and α-hydroxypropiosyringone (XXVII) belong to the class of substances known as benzoins, the latter being characterized by the ease with which they are converted, under the influence of mild reagents such as anhydrous alcohols in presence of hydrochloric acid, into amorphous products or resins of unknown composition *(42)*. Such changes take place to a less extent with ethyl than with methyl alcohol and it is largely on this account that it has been possible to isolate, readily, from wood, the above mono-molecular benzoin type alkyl ether building units by ethanolysis.

Another important property of some benzoins is their tendency to undergo, under the influence of mild chemical reagents, intramolecular "dismutation" transformations *(43)*, the intermediate product being an *ene-diol*. In general, these dismutation changes are equilibrium reactions involving hydrogen migrations, the amounts of each component varying with the structure concerned.



It can be seen that (XXVI) differs from (XXXI) and (XXXII) in that migration of *one* hydrogen atom has occurred to give the ene-diol (XXXI) and of two hydrogen atoms to form (XXXII). Ene-diols readily undergo dehydrogenation to 1:2-diketones, which in turn reunite with hydrogen to reform the ene-diols *(43)*, as exemplified in the well-known oxidation-reduction changes occurring in the quinone-hydroquinone system.

Relation of Above Units to Plant Synthesis and Lignin Formation

The mechanism by which a plant synthesizes products such as starch, cellulose, sugars, phenolic substances, etc., is quite unknown, as is also that involved in plant respiration. The latter phenomenon, in the case of animal cells, has engaged the attention of a large number of workers in biochemistry during the last twenty to thirty years and it is only quite recently that a clearer picture of the process has been developed. It is now accepted by most workers in this field *(44)* that the energy necessary for the animal cell is provided by the transformation of fuel, in the form of carbohydrate, into carbon dioxide and water. This conversion is effected through a system of energy-liberating, oxidation reactions, which take place by means of a somewhat complex series of dehydrogenations and decarboxylations. Only a relatively small amount of energy is provided by the decarboxylation reactions—that is, in the changes concerned with the liberation of carbon-dioxide from specific dicarboxylic acids. The greater part is derived from the formation of water from the union of hydrogen and oxygen, possibly through an intermediary hydrogen peroxide stage. The carbohydrate, hexose, is split into trioses and from the latter fragments, hydrogen is removed under the influence of enzymes known as dehydrogenases. The latter are proteins to which other specific groups are attached. The hydrogen thus removed is transported to another substance known as a "carrier" or "hydrogen transporter." The dehydrogenases thus catalyze the transfer of hydrogen from one derivative to another and function in a highly efficient, specific manner. In this manner a chain of reactions is established which serves to transport hydrogen from negative to increasingly more positive (less negative) oxidation-reduction systems until finally the stage of union with oxygen is reached. In this process the large amount of energy involved in the formation of water from hydrogen and oxygen is liberated step-wise, and in small increments, in the course of each of a series of dehydrogenation reactions and provides the energy for plant growth (respiration).

One of the principal systems of dehydrogenase catalysts, active in animal cell respiration, has been shown by Szent-Györgyi to consist of a series of four-carbon dicarboxylic acids (the C_4-system) and indicated in Fig. 1. These catalysts serve as transport media for the hydrogen supplied by the carbohydrate.

In his recent Nobel prize lecture *(45)* Szent-Györgyi pointed out that, while a great deal has been learned about the mechanism of animal cell respiration, very little is known concerning that of the plant. However, as a result of a series of researches carried out with various forms of plant life, he has been able to demonstrate the existence therein of a number of dehydrogenase-catalyst systems, such as catechol *(46a)* (XXXIV), ascorbic acid *(46d)*

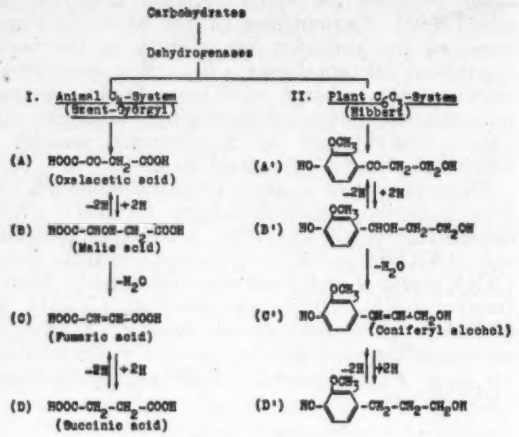
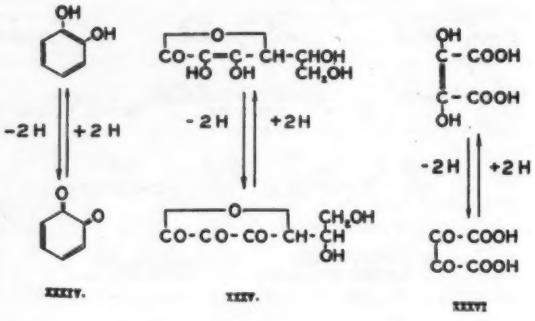


FIG. 1

(XXXV), and dioxymaleic acid *(46c)* (XXXVI).

Each of these can function as an oxidation-reduction system, the oxidized molecule being a 1,2-



diketone (A) and the reduced molecule (B) an ene-diol.

He explains the turning brown of freshly exposed apples, bananas, and other plant tissue, as due to the formation of these 1, 2-diketone systems, which are very unstable and undergo rapid conversion, under the influence of small amounts of chemical reagents (alkalies, etc.), into complex organic substances of unknown composition. It is probable that the discoloration of newsprint is due to the same cause. The above ene-diols, when synthesised outside the plant, are much more stable than their corresponding diketones. From these experiments and other theoretical considerations, Szent-Györgyi has been led to conclude that, irrespective of any other system which may function in plant respiration, there must be present oxidation-reduction configurations of the ene-diol type.

It is thus of considerable interest that the principal water-soluble, ethanolysis products isolated from spruce and maple wood represent ene-diol, 1,2-diketone oxidation-reduction systems (XXXI), (XXXIII).

Inasmuch as these, in turn, are apparently some of the building-units from which lignin is formed, the suggestion seems warranted that the latter is derived from a series of monomolecular, hydrogen-transporting plant catalysts, which, during the life of the plant and in the subsequent post-mortal stage,

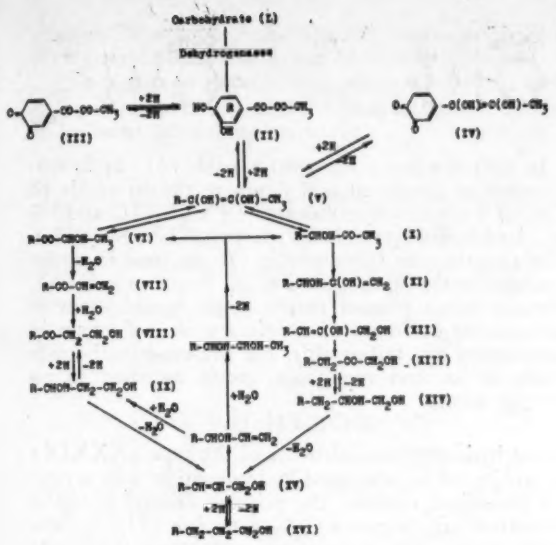


FIG. 2

Suggested Mechanism of Plant Respiration. R = Catechol in Initial Stages. Following Methylation, R = Guaiacyl (Soft Woods and Both Guaiacyl and Syringyl (Hard Woods).

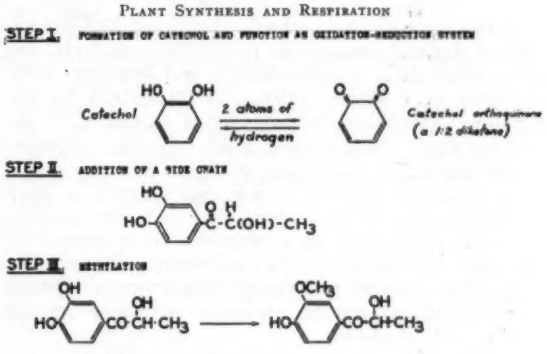


FIG. 3A

undergo conversion into more complex condensation polymer products.

One other point calls for comment in this connection, namely, the widespread occurrence of coniferin in the cambial sap of practically all plants during the active cycle of plant growth. This and other considerations have led the author to suggest the possible presence of an, as yet, unidentified system of plant respiratory catalysts corresponding to the C_4-dicarboxyllic acid system of Szent-Györgyi (Fig. 1).

In this new system (Fig. 1) it is seen that the third member is coniferyl alcohol corresponding to fumaric acid in the C_4 system. Evidence is accumulating that products of types (A′) and (B′) Fig. 1, are actually present in young woody tissue, while in addition to A′ there also may be present the isomeric forms of A′ and B′, namely $R\text{-}CH_2CO\text{-}CH_2OH$ and $R\text{-}CH_2\text{-}CHOH\text{-}CH_2OH$. If this theory is true it is to be expected that a simple relationship should exist between the above C_6-C_3 units and the previously mentioned ene-diol-diketone systems, and such a relationship is shown in Fig. 2. A suggested mechanism of plant synthesis is shown in Fig. 3.

Hydrogenation and Hydrogenolysis of Wood and Extracted Lignins

Some very interesting and important results have recently been obtained by hydrogenating wood and lignins at high hydrogen pressures and relatively high temperatures.

An initial experiment, carried out in 1937 by

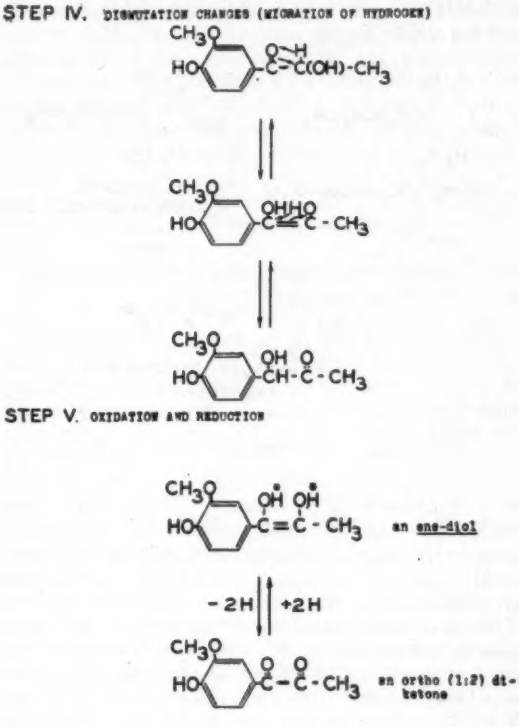


FIG. 3B

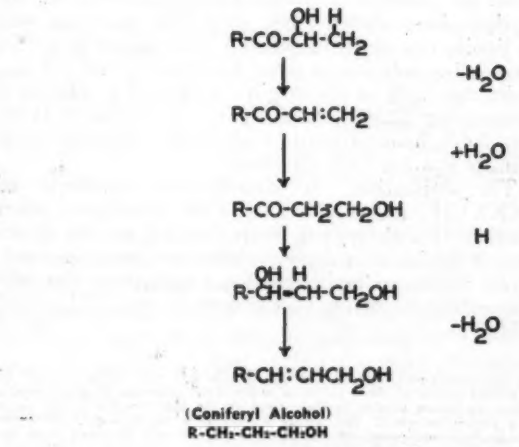
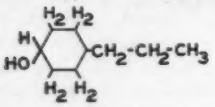


FIG. 3C

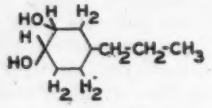
Adkins at the University of Wisconsin, on a sample of acetic acid lignin sent for investigation by the writer, showed that by suspending this in dioxane, using a copper-chromium oxide catalyst, a hydrogen gas pressure of 300-400 atmospheres and a temperature of 250 deg. C., considerable reduction of the lignin occurred. No products were isolated.

Following this first experiment, Harris, D'Ianni, and Adkins, *(47)* investigated the reduction of a methanol aspen lignin and isolated in considerable quantity three new substances, 4-n-propylcyclohexanol-1(XXXVII); 4-n-propylcyclohexanediol-1,2 (XXXVIII) and 3-(4-hydroxycyclohexyl) propanol-1 (XXXIX).



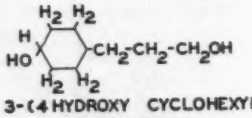
4- n PROPYL CYCLOHEXANOL-1

XXXVII.



4 n PROPYL CYCLOHEXANE DIOL-1 2

XXXVIII.



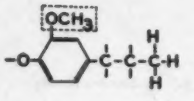
3-(4 HYDROXY CYCLOHEXYL) PROPANOL-1

XXXIX.

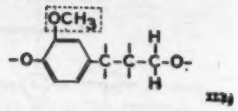
The structure of products (XXXVII) and (XXXVIII) was definitely proven by their direct synthesis by Harris, D'Ianni, and Adkins *(47)* and, recently that of compound (XXXIX) by Bowden and Adkins *(48)*. The first-named authors claimed *(47)* to have obtained a combined yield of the three products, amounting to about 40%, calculated on the weight of methanol lignin, but as the weight of water formed was omitted from their calculations, the values call for correction in this respect. In later papers, by Harris and co-workers *(49)* new data are given for lignin from aspen woods.

Following the earlier experiments of Harris, D'Ianni and Adkins, the hydrogenation of maple wood was investigated by us *(50)* and two of the above products (XXXVII) and (XXXIX) isolated from the reaction mixture.[5] Recently Harris and co-workers have shown *(49b, 49c)* that wood, as well as lignin, can be hydrogenated over Raney nickel in an alkaline solution at more moderate pressures and claim that 18% of the original weight of maple wood (containing 22.5% Klason lignin) is obtainable as indentifiable hydroaromatic compounds, although their identity has not been disclosed.[6]

The formation, in considerable amounts, of (XXXVII) and (XXXIX) is of importance when considered with regard to its bearing on the structure of lignin, since these cyclohexane derivatives evidently represent hydrogenation products of the corresponding aromatic C_6-C_3 derivatives, (XL) and (XLI).



XL.



XLI.

In the meantime it has been possible *(51)* by hydrogenation of maple ethanol lignin to obtain yields of 12% of 4-n-propylcyclohexanol-1 (XXXVII) and 3% of 3-(4-hydroxycyclohexyl)propanol-1 (XXXIX). The fact that the latter product is obtained in larger amount in the hydrogenation of maple wood *(52)* than in using ethanol maple *lignin* would seem to indicate the existence of a *primary alcohol* group in protolignin, or, failing this, the presence in the side chain of an end methylene group attached to an oxygen atom:

R-C-C-CH_2-O-

When hydroaromatic alcohols of the type (XXXIX) are subjected to prolonged hydrogenation with a copper chromium catalyst, the primary alcohol group is converted largely into a CH_3- grouping *(51)*. It thus seems permissible to draw the conclusion that units of the coniferyl- or oxy-coniferyl types are present in protolignin and probably in large amount. There is strong evidence for the presence in lignin of the two building-unit types R-C-C-CH_3 and R-C-C-C-OH.

Nature of Protolignin

In the light of the author's theory of lignin as a product derived from plant respiratory catalysts, the latter, from their assumed nature and function, must represent very labile systems, characterized by remarkable activity of the side chains (attached to the benzene ring) toward even mild chemical reagents. These respiratory catalysts, or lignin-building units, differ from one another in principle merely in their relative degrees of hydrogenation, or hydroxylation, and some correspond, in a general way, to certain of the units postulated by Freudenberg. Structurally they differ only in containing either two additional hydrogen atoms or the elements of water in the -C-C-C- side chain.

In view of their postulated remarkable chemical activity, it is scarcely to be expected that, even if they existed in the living cells of the plant in simple monomolecular form, it would be possible readily to effect their isolation in an unchanged state. Marked changes must occur during the postmortal period, so that protolignin may be regarded as a mixture of (a) relatively simple and reversible combinations of these monomolecular units with similar units, or with carbohydrates; and (b) their more complex polymerization-condensation products. It is thus of interest to inquire into the possible mechanism of formation of the latter, either as they exist in the plant, or as isolated in the extraction process.

Mechanism of Polymerization of Lignin Building Units

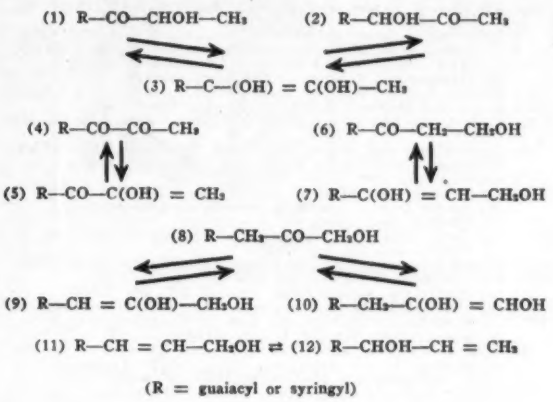
It would seem that of the various respiratory dehydrogenation systems postulated in Fig. 2, probably only those of a less hydrogenated type will be present in the postmortal stage of plant life in view of the probable changes in the cell content and cell wall under the influence of an increasingly oxidizing environment. This view is partly supported by the fact that coniferyl alcohol disappears as the cell activity diminishes, while products such as *a*-hydroxy-propiovanil-

[5] The previous claim by Godard, McCarthy, and Hibbert *(50)* of very high yields of these products in the hydrogenation of maple wood, under conditions similar to those used by the above workers, has since been shown incorrect. The yields are actually much lower, the error arising from acceptance of refractive index criteria obtained from incompletely fractionated material.

[6] In the writer's opinion these yields require confirmation and the subject is being investigated in these laboratories.

tone and vanilloyl methyl ketone, representing more highly oxidized systems, can be readily isolated.

The nature of the lignin polymers would thus seem to be associated essentially with postmortal changes in units of the following types:



These derivatives, containing a phenol group together with a carbonyl group or an unsaturated ethylene linkage, will have a strong tendency to undergo *para-* and *ortho*-nuclear condensations, both individually and collectively, under very mild conditions, with formation of condensation polymers. The phenol-carbonyl type of reaction was investigated by Michael *(53)* nearly sixty years ago and postulated by him as that probably taking place in the plant formation of "resins" from aldehydes and phenols. An example of this condensation type of polymer formation is shown in Fig. 4.

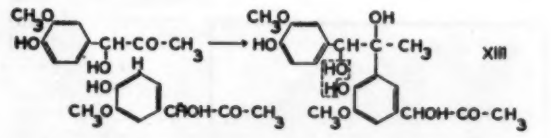


FIG. 4

It can be seen that this differs from Freudenberg's mechanism only in the *order* in which the first two steps are assumed to occur.

Polymerization Mechanism of Syringyl Building Units

It is evident that the above types of polymerization cannot take place with the syringyl (C_6-C_3) derivatives since in the benzene nucleus both positions *ortho* to the phenol group are blocked and other mechanisms must be postulated. One interesting possibility lies in the assumption that guaiacyl and syringyl units may function as dioxystyrene derivatives, for example, (B) and (D):

(A) R—CO—CH_2—CH_2OH ⇄ (B) R—C(OH) = CH—CH_2OH
(C) R—CO—CHOH—CH_2 ⇄ (D) R—C(OH) = C(OH)—CH_2 ⇄
(E) R—CHOH—CO—CH_2

which could undergo typical styrene-type polymerizations.

Other types of polymerization, for example, that involving condensation between a carbonyl group of one molecule and a methyl group of another, may also occur, the change being favored by presence of alkali. The view that the above types of respiratory catalysts probably play an important role in lignin formation finds experimental support in the isolation of haloforms *(54)* and of acetic acid from lignin in considerable amount *(55)* both results indicating the presence of terminal methyl groups. Regarding presence of a terminal carbinol (-CH_2OH) group in lignin, support for this may be seen in the wide occurrence of coniferin in young plants and the recent isolation from the hydrogenation products of both lignin and wood of cyclohexyl derivatives containing the side chain -CH_2-CH_2-CH_2OH. The above-mentioned C_6-C_3 units are believed to exist as simple glycosides in the early stage of cell plant wall development, the formation of the more complex polymeric forms taking place later and especially in the postmortal stage. The mechanisms of polymerization suggested above are as yet entirely of a theoretical character and represent only a few of a number of possibilities. Much further patient and intensive effort will be necessary before this problem can be solved.

Nature of Union Between Lignin and Other Plant Constituents

There seems to be a somewhat general agreement that, in the plant, lignin is attached to carbohydrates, possibly to a polyuronide, but the nature of the linkage is as yet undefined. It must, however, be restricted to a few types only, the most probable being either glycosidic or ether unions. The experimental work *(56)* on model substances indicates the improbability of the presence of the former while, due to experimental difficulties which have not as yet been overcome, it has not so far been possible to investigate the latter.

It is of interest, however, that a reasonably rapid fission of the lignin from the attached polysaccharides by the action of organic solvent only occurs at a temperature of about 140-170 deg. C., thus indicating a relative stability of the chemical union. For example, experiments carried out on the removal of lignin by aqueous aliphatic alcohols have shown that practically the entire lignin content can only be removed by heating under pressure for several hours at 158-168 deg. C. this being much facilitated by the presence of small amounts of alkalies or acids *(57)*. Recent experiments *(58)* have confirmed the ease of this extraction using ethanol solutions.

Almost complete lignin removal also can be brought about by the use of aqueous solutions of certain organic salts such as sodium xylene sulphonate under similar temperature conditions *(59)*. By the use of acetylating agents in an acidic hydrolysing medium *(60)* the cleavage of the union takes place at a much lower temperature and to an extent dependent on temperature and reagents used.

These results indicate the possible existence in the plant of a stable linkage, possibly of an ether type, between lignin and carbohydrates.

Considerable further investigation is necessary, but sufficient knowledge already has been obtained to warrant the belief that, within the next few years, based on a better and more complete knowledge of lignin structure, new, efficient and more economical methods of pulp manufacture will be developed, by means of which not only pulp of high quality will be

obtained, but also the incrustants isolated in a form suitable for chemical and other utilization.

Acknowledgment

The above researches, extending over a period of some fourteen years, represent the joint efforts of the author and a large number of graduate students, post-doctorate students, and co-workers to whom the writer wishes to express deep indebtedness for their tireless efforts and support. In particular he wishes to acknowledge the kind help given to him in the earlier period by his former co-worker, Dr. F. Brauns, and to express his indebtedness to Dr. G. Wright, Dr. J. L. McCarthy, and Dr. W. L. Hawkins, Sessional Lecturers in the Division of Industrial and Cellulose Chemistry, for their very valuable assistance, and enthusiastic and loyal support during the last four or five years.

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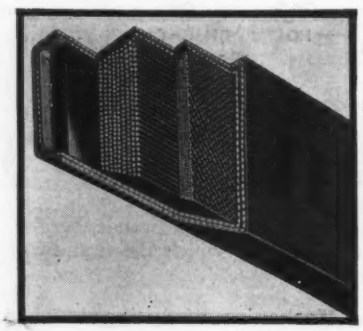

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Effective September 30, 1939, under Treasury Decision 49,970, all publications, exchanges and trade associations, were denied access to import manifests at the New York Customs House. The Paper Trade Journal and other interested parties have vigorously protested this ruling, and as soon as the order of the Treasury Department is modified or rescinded, full publication of all manifests will be resumed in these columns. In the interim, the Paper Trade Journal is making every possible effort to gather all available information from manifests, at various outside sources.

NEW YORK IMPORTS

WEEK ENDING JULY 19, 1941

SUMMARY

Cigarette paper .....4 cs.
Newsprint .....8,998 rolls.

CIGARETTE PAPER

Suarez & Crespo, ——, Alicante, 4 cs.

NEWSPRINT

H. G. Craig Co., Inc., ——, Donnacona, 270 rolls.
——, ——, Comeau Bay, 3,197 rolls.
H. G. Craig Co., Inc., ——, Donnacona, 354 rolls.
——, ——, Canada, 5,177 rolls.

RAGS, BAGGINGS, ETC.

Castle & Overton, Inc., ——, Montevideo, 15 bls. rags.
A. W. Fenton, Inc., ——, Montevideo, 5 bls. old hemp rags.
S. Szbrinski, ——, Montevideo, 2 bls. old hemp rags.
F. Stern, ——, Montevideo, 1 ble old hemp rags.
Guaranty Trust Co., ——, Buenos Aires, 4 bls. old knits.
Irving Trust Co., ——, Maceio, 318 bls. cotton residue.
——, ——, Cabedello, 217 bls. cotton residue.
Irving Trust Co., ——, Cabedello, 52 bls. cotton residue.
——, ——, Cabedello, 1,082 bls. cotton linters.
Lush Cotton Products Co., ——, Natal, 130 bls. cotton linters.
C. Kutz, ——, Fortaleza, 26 bls. cotton residue.
National City Bank, ——, Buenos Aires, 7 bls. old rags.
New England Waste Co., ——, Bombay, 100 bls. cotton waste.
Camden Fibre Mills, ——, Bombay, 100 bls. cotton waste.
O'Brien Products, Inc., ——, Bombay, 200 bls. cotton waste.
——, ——, Santos, 210 bls. cotton linters.
——, ——, Santos, 128 bls. cotton linters.
C. Comiter Co., ——, Rio de Janeiro, 100 bls. cotton linters.

WOOD PULP

——, ——, Yarmouth, 1,177 bls. wood pulp.

GLUE STOCK, ETC.

Milligan & Higins Corp., ——, Buenos Aires, 52 bls. glue stock.
Biological Raw Products, Inc., ——, Buenos Aires, 290 bags skin glue.
Darmstadt Scott & Courtney, ——, Bombay, 409 bls. old pickers.
H. Remis & Co., ——, Tampico, 104 bls. leather waste.
——, ——, Santos, 200 bags bone glue.

CASEIN

Bank of London & South America, ——, Buenos Aires, 334 bags.
American British Chemical Supplies, ——, Buenos Aires, 834 bags.
——, ——, Buenos Aires, 50 bags.
H. S. Cramer & Co., ——, Buenos Aires, 167 bags, 10,020 kilos.
National City Bank, ——, Buenos Aires, 334 bags (Ground), 20,000 kilos.
H. S. Cramer & Co., ——, Buenos Aires, 1,000 bags (Unground), 50,000 kilos.
Chase National Bank, ——, Buenos Aires, 917 bags (Ground), 55,020 kilos.
American Cyanamid & Chemical Corp., ——, Buenos Aires, 250 bags, 15,000 kilos.

PHILADELPHIA IMPORTS

WEEK ENDING JULY 19, 1941

American Cyanamid & Chemical Corp., ——, Buenos Aires, 667 bags casein, 40,020 kilos.

Paper Men Play Golf

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., July 21, 1941—Last Tuesday, fifty-two members of the Philadelphia Paper and Cordage Association, motored out to St. Davids Golf Club in Wayne for its monthly golf tournament. The host on this occasion was Hugo H. Hanson, president of W. C. Hamilton & Sons, and the Fred Brower-Atlantic Trophy was put into competition. The rules governing this trophy were: The six low net scores to qualify; the four lowest to compete at Match Play Handicap at Old York Road on August 20, or at Aronomink on September 17—this being optional. If any of the four lowest qualifiers do not play off their matches on either August 20 or September 17 they shall default and the other two qualifiers will be considered in the competition. The finals will be played at Pine Valley on October 7. Stymies will not be played in the matches, and all putts must be holed in the qualifying round.

Collins Mfg. Co. Made Agents

[FROM OUR REGULAR CORRESPONDENT]

PHILADELPHIA, Pa., July 21, 1941—A. M. Collins Manufacturing Company, coated paper manufacturers in this city, have been appointed exclusive sales agents for the Collins Manufacturing Company, fine paper manufacturers of North Wilbraham, Mass., according to an announcement made by Paul C. Bast, treasurer of the latter named company. Frederick E. Macy, president of A. M. Collins Manufacturing Company, who will be in charge of the management of manufacturing operations at North Wilbraham, will also continue as prexy in Philadelphia.

Geo. W. Millar & Co. Give Bonus

Once again the employees of Geo. W. Millar & Co., Inc., were gladdened by a semi-annual bonus of a weeks salary which came to them on July 17, and which was paid out of earnings covering the first half of 1941.

At a meeting of the board of directors held on June 27, 1941 William Goirn, who has been with the company for 39 years, was elected secretary to succeed George W. Hall who died May 30, 1941.

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Consistency Regulators
Do Regulate

WE HAVE THE PROOF

They
- Are easily installed.
- Have only one adjustment.
- Consume very little power.
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- Are accurate, dependable and rugged.

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LOCKPORT, NEW YORK

West Virginia Pulp and Paper Company

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503 Market St., San Francisco, Cal.

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and LITHOGRAPHIC PAPERS

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Luke, Maryland
Covington, Virginia
Tyrone, Pennsylvania
Williamsburg, Pennsylvania
Cass, West Virginia
Charleston, South Carolina

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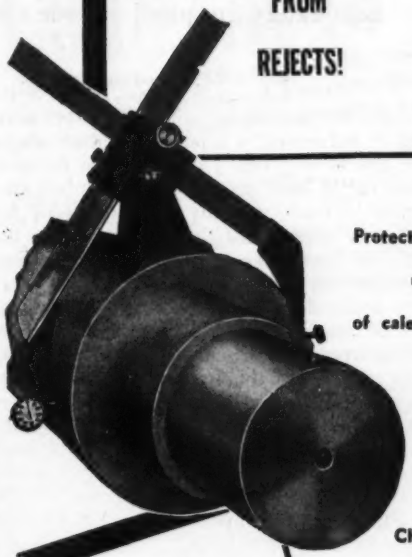

Protects you against unsuspected wear of calender and press rolls! Insures you against rejects resulting from wear on rolls! Checks regrinding the easiest way!

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This handy Caliper is light in weight, easy to use, quickly adjustable to wide range of roll diameters. Shows accurately the slightest wear, stops rejects piling up, yet, only 69c a day pays for this positive protection!

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New York Paper and Pulp Market Review

Record Breaking Paper Output This Year Likely To Exceed Earlier Trade Estimates—Pulp Market Strong and Some Mills Inadequately Supplied—Some Grades of Paper Stock Up This Week.

Office of the PAPER TRADE JOURNAL,
Wednesday, July 23, 1941.

More comment is heard in the wholesale paper market this week in reference to a possible future shortage of paper, due to very heavy demands for defense. Although the OPM has predicted that substantial reductions must be made in many kinds of goods for civilian uses, some quarters of the paper trade do not share the opinion that there is likely to be a serious shortage of paper for normal uses.

The heavy demand for all major lines of paper continues to be reflected in reports received from many manufacturers' representatives, jobber, and general paper merchants this week. Backlog orders are accumulating and in some cases deliveries are several weeks behind orders, with practically all mills operating at capacity.

The index of general business activity for the week ended July 12 declined to 128.6%, from 130.5% for the preceding week, compared with 106.2% for the corresponding week for 1940.

Paper production for the week ended July 12 was estimated at 95.8%, compared with 91.1% for 1940, with 78.8% for 1939, with 75.7% for 1938, and with 85.9% for the corresponding week for 1937.

Paper board production for the week ended July 12 was 77.0%, compared with 72.0% for 1940, with 71.0% for 1939, with 65.0% for 1938, and with 74.0% for the corresponding week for 1937.

An unprecedently heavy demand for all major grades of paper continues with the probability that production this year may reach the estimated 18,500,000 tons which the OPM set as required to meet all demands for the current year. At this date no important changes from prevailing average representative market quotations have been reported.

Chemical Pulp

The chemical pulp market is in a very strong position, with the production of some converting mills affected by the increasing scarcity of pulp. All prime grades are selling at a substantial premium in the spot market, although contract prices are unchanged for the third quarter. The OPM forsees a shortage in pulp and in transportation.

Rags

Demand for paper making rags continues to be reported active. No important change has occurred this week, except on the blue overall grade which has advanced and currently quoted at from 4.75 to 5.00.

Roofing rags are in a strong position this week, with some quarters of the trade reporting higher prices. No important changes from average representative market quotations has occurred at this date.

Old Rope and Bagging

The old rope market is in a strong position under a steady demand with supplies of No. 1 Manila rope limited. Strings and threads of imported fibers are very firm at this date.

Scrap bagging is reported in a strong market position, with high prices being paid for some grades of gunny. The roofing grades are very firm with prices unchanged at this date.

Old Waste Paper

Some of the higher grades of old waste paper, such as white and manila cuttings, are currently reported scarce. Advances have occurred this week on white ledger stock, currently quoted at from 1.85 to 1.90; new Manila envelope cutting, at from 3.25 to 3.50; and in new cuttings, at from 3.00 to 3.25.

Twine

The twine market is in a strong position, with an unprecedently heavy demand for both hard and soft fiber twines. Trade reports continue to reflect the "tight" situation in imported fibers. Prices are firm and unchanged.

C. D. Allen Heads Pacific Box Makers

The Pacific Coast Paper Box Manufacturers Association at its twenty-seventh annual convention elected C. D. Allen of Oakland as president to succeed Joe O'Reilly of Seattle, Wash.

Other officers are: O. C. Major of Los Angeles, vice president; Parpon Thompson of Portland, treasurer; Herman H. Emme of Seattle, Kramer Barnes of Emeryville and Charles Ruble, executive committee, folding box division; and W. D. Grigsby of Portland, Sam Platt of San Francisco and Clarence B. Kerr of Los Angeles, executive committee, set up box division.

Paper and Its Performance

A booklet under the title of "Paper and its Performance," just issued by the P. H. Glatfelter Co., Spring Grove, Pa., is a sequel to a "Short Course in Paper Making," issued by the company in 1939.

The latest publication presents basic procedures in the manufacture of fine printing papers. The contents include raw materials and pulp preparation, formation of the sheet of paper and finishes. The performance of paper and inks, together with various major considerations in printing are discussed.

A copy of the booklet may be obtained, without charge, from the Glatfelter Co. by all members of the graphic arts industries.

Quincy P. Emery Made Vice-President

The Stevens-Nelson Paper Corporation, 109 East 31st street, New York, N. Y., announces that Quincy P. Emery has been made vice-president of the organization, and brings to the corporation his extensive sales experience in the domestic paper industry. This makes available a most efficient service for the solution of paper problems, with a range of domestic papers notable for their versatility, the company states.

INDUSTRIAL DEPARTMENT ★ SEABOARD AIR LINE RAILWAY
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This grade of TiO_2 shows highest developments of aqueous dispersion and suspension yet attained.

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BUT also a guarantee by men who for 75 years have prided themselves in making finer felts. TO YOU —this is the mark of dependability, longer felt life and greater saving.

KNOX WOOLEN CO.
CAMDEN, MAINE.

MISCELLANEOUS MARKETS

Office of the PAPER TRADE JOURNAL,
Wednesday, July 23, 1941.

BLANC FIXE—Quotations on blanc fixe are firm and continue unchanged at prevailing market levels. Demand reported steady for the week. The pulp is currently quoted at $35 per ton in barrels, at works; the powder is offered at $50 per ton, f.o.b., works.

BLEACHING POWDER—Prices on bleaching powder are firm. Market active and demand from regular consumers good. Bleaching powder is currently quoted at $2 per 100 pounds, in drums, at works.

CASEIN—Quotations on casein are higher. Demand active for the week. Standard domestic casein, 20-30 mesh, is currently quoted at 22 cents per pound; 80-100 mesh, at 22½ cents per pound; all prices in bags, car lots. Standard Argentina casein is currently offered at 21 cents per pound. No quotations on French casein.

CAUSTIC SODA—Prices on caustic soda are unchanged. Demand reported heavy for the week. Solid caustic soda is currently quoted at $2.30 per 100 pounds, flake and ground at $2.70 per 100 pounds, in drums, at works.

CHINA CLAY—Quotations on china clay are firm and continue unchanged this week. Domestic filler clay is currently quoted at from $7.50 to $15 per ton; coating clay at from $12 to $22 per ton, at mines. Imported clay is quoted at from $13 to $25 per long ton, ship side.

CHLORINE—The demand for chlorine is reported heavy. Prices are firm and the market is subject to priority ruling. Chlorine is currently quoted at $1.75 per 100 pounds, in single-unit tank cars, f.o.b., works.

ROSIN—Quotations on most grades of rosin are unchanged for the week. "G" gum rosin is currently quoted at $2.35 per 100 pounds, in barrels, Savannah. "FF" wood rosin is currently quoted at $2.35 per 100 pounds, in barrels, New York. Seventy per cent gum rosin size is quoted at $2.89 per 100 pounds, f.o.b., works.

SALT CAKE—Prices on salt cake are firm. Demand good, with current quotations nominal. Domestic salt cake is currently quoted at $16 per ton in bulk; chrome salt cake at $16 per ton. All prices in car lot, f.o.b., shipping point. The quotation of $16 per ton on imported salt cake continues nominal.

SODA ASH—Quotations on soda ash are firm and continue to conform to prevailing market quotations. Demand reported good. Quotations on soda ash in car lots, per 100 pounds, are as follows: in bulk, $.90; in paper bags, $1.05; and in barrels, $1.35.

STARCH—Prices on corn starch are firm and continue unchanged for the current week. Pearl is currently quoted at $3.10 per 100 pounds; powdered starch at $3.20 per 100 pounds; all prices in bags, car lots, f.o.b., Chicago.

SULPHATE OF ALUMINA—Quotations on sulphate of alumina are firm. Demand active for current week. The commercial grades are currently quoted at $1.15 per 100 pounds; iron free at $1.60 per 100 pounds, in bags, car lots, f.o.b., works.

SULPHUR—Prices on sulphur are firm and continue to conform to prevailing market quotations. Annual contracts are currently quoted at $16 per long ton, f.o.b., mines. Spot and nearby car lots are quoted at $19 per ton.

TALC—Quotations on talc are firm and continue unchanged at prevailing market prices. Domestic talc is currently quoted at from $15 to $21 per ton, at mills. No quotations on imported talc.

MARKET QUOTATIONS

Paper

(Delivered New York)

News, per ton—			
Roll, contract	$50.00	@	—
Sheets	58.00	"	—
Kraft—per cwt.—Delivered Zone A			
Northern, Extra Quality	$5.25	@	$6.00
Superstandard	4.87½	"	5.25
Northern Standard Wrapping	4.50	"	5.00
Standard Wrapping	4.50	"	—
Tissues—Per Ream—Carlots			
White No. 1	.97½	"	—
White No. 1 M. G.	.95	"	—
White No. 1½	.80	"	—
White No. 2	.75	"	—
Anti-Tarnish M. G.	.80	"	—
Colored	.85	"	—
Kraft	.87½	"	—
Manila	.77½	"	—
Unbl. Toilet, 1 M.	3.75	"	—
Bleached Toilet	5.26	"	—
Paper Towels, Per Case—			
Unbleached, Jr.	2.10	"	—
Bleached, Jr.	3.60	"	—
Manila—per cwt.—C. l. f. a.			
No. 1 Jute	8.75	@	10.75
No. 1 Manila Wrapping, 35 lb.	5.50	"	5.75
No. 2 Manila Wrapping, 35 lb.	5.25	"	5.50
Boards, per ton—			
News	42.50	@	—
Chip	42.50	"	—
Sgl. Mia. LL. Chip	57.50	"	—
White Pat. Coated	72.50	"	—
Kraft Liners	60.00	"	—
Binders Boards	80.00	"	—

The following are representative of distributors' resale prices:

Rag Content Bonds and Ledgers—White, Assorted Items, Delivered in Zone 1:

	Bonds		Ledgers	
100% Rag Ext. No. 1	$39.10 @	$46.00	$40.25 @	$47.25
100% Rag	31.05 "	36.50	32.20 "	37.75
85% Rag	.... "	....	29.90 "	35.00
75% Rag	23.60 "	27.75	24.75 "	29.00
65% Rag	.... "	....	21.65 "	26.25
50% Rag	17.55 "	21.50	18.70 "	22.75
25% Rag	14.65 "	17.75	15.80 "	19.25

Colors at $1.00 cwt. extra.

Sulphite Bonds and Ledgers—White, Assorted Items. Delivered in Zone 1:

	Bonds		Ledgers	
No. 1	$9.35 @	$11.50	$11.55 @	$12.75
No. 2	8.50 "	10.25	9.65 "	11.75
No. 3	8.05 "	9.25	9.20 "	11.25
No. 4	7.70 "	9.50	8.90 "	10.75

Colors $1.00 cwt. extra.

Free Sheet Book Papers—White, Cased Paper.

Delivered in Zone 1:

No. 1 Glossy Coated	$11.90	@	$13.50
No. 2 Glossy Coated	10.35	"	11.75
No. 3 Glossy Coated	9.55	"	11.00
No. 4 Glossy Coated	9.15	"	10.50
No. 1 Antique (watermarked)	9.05	"	10.50
No. 2 Offset	8.40	"	9.75
A Grade E. F.	8.20	"	9.50
A Grade S. & S. C.	8.45	"	9.75
B Grade E. F.	7.65	"	8.75
B Grade S. & S. C.	7.90	"	9.00
C Grade E. F.	7.35	"	8.50
C Grade S. & S. C.	7.60	"	8.75
D Grade E. F.	7.10	"	8.25
D Grade S. & S. C.	7.35	"	8.50

Ivory & India at $.50 cwt. extra.

Mechanical Pulp

(On Dock, Atlantic Ports)

No. 1 Imported—			
Moist	No prices		
Dry	No prices		
(Delivered)			
No. 1 Domestic and Canadian	40.00	@	42.00

Chemical Pulp

(On Dock, Atlantic, Gulf and West Coast Ports)

Bleached Sulphite (Domestic and Foreign)—			
Prime Bleached Sulphite	3.72½	@	3.87½
Prime Qualities—			
Easy-Bleaching Sulphite	3.17½	"	3.75
Strong Unbleached Sulphite	3.17½	"	3.75
News Grade, delivered			
Unbleached Sulphite	61.00	"	64.25
(On Dock, Atlantic Ports)			
Kraft Bleached	4.12½	"	—
Kraft Light & Strong	3.75	"	4.15
Kraft No. 1	3.60	"	4.00
(F. o. b. Pulp Mill)			
Kraft Domestic and Canadian	2.75	"	3.37½
(Delivered)			
Soda Bleached	3.30	"	—

Add 60 cents per short ton, dock charges for Albany; $2.50 for Lake Ports East and $3.50 for Lake Ports West of Mackinac Straits.

Domestic Rags

New Rags

(Prices to Mill f. o. b. N. Y.)

Shirt Cuttings—			
New White, No. 1.	6.00	@	6.25
Silesias No. 1	4.25	"	4.50
New Unbleached	6.00	"	6.25
Blue Overall	4.75	"	5.00
Fancy	2.25	"	2.50
Washables	2.00	"	2.15
Mixed Khaki Cuttings	2.50	"	2.75
O. D. Khaki Cuttings	3.00	"	3.15

Old Rags

White, No. 1—			
Repacked	3.10	"	3.35
Miscellaneous	2.35	"	2.65
White, No. 2—			
Repacked	2.50	"	2.75
Miscellaneous	2.00	"	2.25
Thirds and Blues—			
Repacked	1.25	"	1.35
Miscellaneous	1.10	"	1.25
Roofing Rags—			
No. 1	1.30	"	1.35
No. 2	1.20	"	1.25
No. 3 (bagging)	.95	"	1.00
No. 4	.90	"	.95
No. 5A	.90	"	.95

Foreign Rags

All prices nominal.

New Rags

New Dark Cuttings	2.25	@	2.40
New Mixed Cuttings	2.00	"	2.20
New Light Silesias	5.50	"	5.75
Light Flannelettes	5.50	"	5.75
New White Cuttings	7.00	"	7.50
New Light Oxfords	4.00	"	4.50
New Light Prints	3.00	"	3.25

Old Rags

No. 1 White Linens	7.50	"	8.50
No. 2 White Linens	6.50	"	7.50
No. 3 White Linens	4.50	"	—

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STURDY SHAFT! Operating Records Prove!

WALDRON Paper Rolls give you more service hours

WHAT A SMOOTH FINISH!

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A GOOD NAME TO REMEMBER FOR ROLLS!

The construction features of Waldron Rolls provide definite advantages in operating efficiency and economy.

CATALOG Sent on Request

It describes the superior materials, the conditioning and careful workmanship that make Waldron Rolls last longer. Write for Catalog 110.

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Wood Pulp & Paper Agents

60 EAST 42 ST NEW YORK CITY

RECORD RUBBER LINED "BONNETLESS" & "SELF-CLEARING" STOCK VALVES BEATS SCARCITY OF STAINLESS STEELS

Photo is of a 6" "RECORD BONNETLESS" Valve having the all important working parts of bronze, assembled in Unit; and clamped between the rubber faced and lined iron body flanged parts.

The WORKING PARTS UNIT consisting of a double seated "RECORD BOXLIKE RENEWABLE SEAT", housing the gate and packing box; and with integrally cast cleanout provision is in reality a valve in itself.

THE GATE OPERATING BETWEEN METAL SEATS WITHOUT CONTACTING RUBBER is a most serviceable and economical solution of the rubber lined stock valve problem.

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RECORD FOUNDRY & MACHINE COMPANY

Livermore Falls, Maine

No. 4 White Linens.	2.25	@	3.25
No. 1 White Cotton.	4.25	"	4.75
No. 2 White Cotton.	3.25	"	3.75
No. 3 White Cotton.	2.50	"	3.00
No. 4 White Cotton.	1.90	"	2.20
Extra Light Prints..	2.00	"	2.40
Ord. Light Prints...	1.75	"	2.15
Med. Light Prints...	1.55	"	1.95
Dutch Blue Cottons.	2.25	"	2.50
French Blue Linens.	3.00	"	—
Checks and Blues...	2.00	"	—
Linsey Garments....	1.90	"	2.00
Dark Cottons.....	1.50	"	1.60
Old Shopperies.....	1.30	"	1.45
New Shopperies.....	1.45	"	1.50
French Blues.....	2.25	"	2.50

Old Rope and Bagging

(Prices to Mill, f. o. b. N. Y.)

Gunny No. 1—			
Foreign	Nominal		
Domestic	4.15	@	4.25
Wool Tares, light....	2.50	"	2.75
Wool Tares, heavy..	2.50	"	2.75
Bright Bagging.....	3.15	"	3.30
Manila Rope—			
Foreign	5.75	"	6.00
Domestic	5.75	"	6.00
Jute Threads.....	2.75	"	3.00
Sisal Strings	2.10	"	2.35
Mixed Strings.....	1.10	"	1.20

Old Waste Papers

(F. o. b. New York)

Shavings—			
White Envelope Cuttings	3.10	@	3.25
Ordinary Hard White No. 1....	2.75	"	3.00
Soft White No. 1..	2.35	"	2.50
Soft White Extra..	2.70	"	2.85
Flat Stock—			
Stitchless	1.10	"	1.25
Overissue Mag.....	.90	"	1.00
Solid Flat Book....	.90	"	.95
Crumbled No. 1...	.70	"	.75
Ledger White Stock.	1.85	"	1.90
Ledger Stock Colored	1.20	"	1.30
Manila—			
New Env. Cut....	3.25	"	3.50
New Cuttings.....	3.00	"	3.25
Old Kraft Machine Compressed bales..	1.35	"	1.50
News—			
No. 1 White News	1.50	"	1.60
Strictly Overissue.	.75	"	.80
Strictly Folded....	.65	"	—
Corrugated	.80	"	—
No. 1 Mixed Paper..	.57½	"	—

Twines

(F. o. b. Mill)

(Soft Fiber)

Coarse Polished—			
India	.20	@	—
White Hemp.....	.20	"	—
Fine Polished—			
Fine India.....	.24	"	—
Unpolished—			
Box	.16¼	"	—
Paper Makers.....	.16	"	—
Tube Rope.....	.17½	"	—
Wall Paper.....	.19½	"	—
Wrapping	.21	"	—
Soft Fiber Rope...	.18	"	—
Cotton	.24	"	—

(Hard Fiber)

Medium Java.....	.15	"	—
Mex. Sisal.....	.14	"	—
Manila	.26	"	—

PHILADELPHIA

Domestic Rags (New)

(Price to Mill, f. o. b. Phila.)

Shirt Cuttings—			
New White No. 1.	.06½	@	.06¾
New White No. 2.	.03½	"	.04
Light Silesias.....	—	"	.04½
Silesias, No. 1....	—	"	.04
Black Silesias, soft	—	"	.03
New Unbleached..	.06¼	"	.06½
Washable Prints..	.02½	"	.03
Washable No. 1..	—	"	.01½
Blue Overall.....	.04	"	.04½
Cottons—According to grades—			
Washable shredding	—	"	.01¾
Fancy Percales....	.03	"	.03¼
New Black Soft...	.02½	"	.02¾
New Light Seconds	—	"	.04
New Dark Seconds	—	"	1.50
Khaki Cuttings—			
No. 1 O. D.....	.03	"	.03¼
No. 2 Mixed.....	.02	"	.02¼
Corduroy	.01¼	"	.01½
New Canvas.....	.04½	"	.05
New Black Mixed.	—	"	.02¼

Domestic Rags (Old)

White No. 1—			
Repacked	3.00	@	3.50
Miscellaneous	2.75	"	3.00
Thirds and Blues—			
Miscellaneous	1.35	"	1.50
Repacked	1.55	"	1.65
Black Stockings (Export)	Nominal		
Roofing Stock—			
Foreign No. 1....	Nominal		
Domestic No. 1...	1.30	"	1.35
Domestic No. 2...	1.10	"	1.15
Roofing Bagging..	1.00	"	1.05

Bagging

(F. o. b. Phila.)

Gunny, No. 1—			
Foreign	3.25	@	3.75
Domestic	3.50	"	3.75
Manila Rope.....	—	"	5.50
Sisal Rope.....	2.00	"	2.25
Mixed Rope.....	.75	"	1.00
Scrap—			
No. 1.....	3.25	"	3.50
No. 2.....	—	"	1.50
Wool Tares, heavy...	4.00	"	4.25
No. 1 New Light Burlap	3.00	"	4.00
New Burlap Cuttings	3.25	"	3.50

Old Papers

(F. o. b. Phila.)

Shavings—			
Hard White Special	2.90	@	3.00
Hard White.....	2.75	"	2.80
No. 1 Soft White..	2.00	"	2.25
No. 2 White.....	1.85	"	1.90
No. 1 Mixed.....	1.00	"	1.20
Solid Ledger Stock..	1.90	"	2.00
Ledger Stock, white.	1.60	"	1.75
Ledger Stock, colored	1.30	"	1.40
No. 1 Books, heavy..	1.15	"	1.20
Manila Cuttings.....	1.90	"	2.00
Print Manila.....	.60	"	.65
Container Manila....	.50	"	.55
Kraft Paper.....	1.45	"	1.50
No. 1 Mixed Paper..	.57½	"	—
Straw Board Chip...	.50	"	—
Binders Board Chip..	.50	"	—
Corrugated Board....	.80	"	—
Overissue News.....	.85	"	.90
Old Newspapers.....	.65	"	—

BOSTON

Old Papers

(F. o. b. Boston)

Shavings—			
No. 1 Hard White	3.15	@	3.25
No. 1 Soft White	2.50	"	2.75
No. 2 Mixed.....	.90	"	1.00
Solid Ledger Books..	2.00	"	2.10
Overissue Ledger Stock	1.75	"	2.00
White Ledger Stocks	1.50	"	1.65
Mixed Ledgers	1.25	"	—
No. 1 Heavy Books	1.10	"	1.20
No. 1 Books, Light..	.75	"	.85
Crumpled Stitchless Book Stock.....	1.15	"	1.20
Manila Env. Cuttings	3.00	"	3.25
Manila Envelope Cuttings, extra quality	2.75	"	3.00
White Blank News..	1.70	"	1.80
No. 1 Kraft.....	1.35	"	1.45
Extra No. 1 Kraft..	1.75	"	—
Mixed Papers.....	.57½	"	—
Print Manila.....	.70	"	—
Container Manila....	.65	"	.75
Old Newspapers.....	.65	"	—
Paper Wool Strings.	1.30	"	1.35
Overissue News.....	.65	"	.70
Box Board Chips....	.35	"	—
Corrugated boxes....	.80	"	.85
Kraft corrugated boxes	1.25	"	1.35
New Kraft Corrugated Cuttings	1.90	"	2.00
Screening Wrappers.	.85	"	.90

Bagging

(F. o. b. Boston)

Gunny Bagging—			
Foreign	(nominal)		
Domestic	4.25	@	4.75
Sisal Rope.....	3.00	"	3.25
Mixed Rope.....	1.00	"	1.25
Transmission Rope—			
Foreign	(nominal)		
Domestic	2.75	"	3.00
Soft Jute Rope.....	4.75	"	5.00
Manila Rope—			
Foreign	(nominal)		
Domestic	6.00	"	6.25
Jute Carpet Threads.	3.00	"	3.25
Bleachery Burlap....	6.00	"	6.25
Scrap Burlap—			
Foreign	(nominal)		
Domestic	3.25	"	3.75
Scrap Sisal.....	3.00	"	3.25
Scrap Sisal for Shredding	3.25	"	3.50
Wool Tares—			
Foreign	(nominal)		
Domestic	4.00	"	4.25
Aust. Wool Pouches.	4.25	"	4.60
New Burlap Cuttings	4.50	"	5.00
Heavy baling bagging	3.50	"	4.00
Paper Mill Bagging..	3.50	"	3.75
No. 2 Bagging.....	.60	"	.75

Domestic Rags (New)

(F. o. b. Boston)

Shirt Cuttings—			
New Light Prints.	—	@	.03
Fancy Percales....	.03½	"	4.00
New White No. 1.	.06¼	"	.06½
New Light Flannelettes	.04¼	"	.04½
Canton Flannel, Bleached	.06½	"	.06¾
Underwear Cutters, Bleached	.06¼	"	.06¾
Silesias No. 1.....	.04¼	"	.04½
New Black Silesias..	4.00	"	—
Red Cotton Cuttings	.04	"	.05
Soft Unbleached....	.06½	"	.06¾
Blue Cheviots.....	.04½	"	.04¾
Fancy	.01¾	"	.02
Washable	.01¾	"	—
Cottons—According to Grades—			
Blue Overalls.....	.04¼	"	.04½
New Black, Soft..	.03	"	.03¼
Khaki Cuttings.....	.02¼	"	.02½
O. D. Khaki.....	.02½	"	.03¼
Corduroy	.02	"	.02¾
New Canvas.....	.05½	"	—
B. V. D. Cuttings...	.06¼	"	.07

Domestic Rags (Old)

(F. o. b. Boston)

White No. 1—			
Repacked	2.75	@	3.00
Miscellaneous	2.00	"	2.25
White No. 2—			
Repacked	1.90	"	2.00
Miscellaneous	2.00	"	2.25
Twos and Blues.....	1.75	"	2.00
Old Blue Overalls...	1.60	"	2.00
Thirds and Blues....	1.50	"	—
Miscellaneous	1.25	"	1.35
Black Stockings.....	3.50	"	4.00
Roofing Stock—			
No. 1.....	1.20	"	1.25
No. 2.....	.95	"	1.00
No. 3.....	.85	"	.95

Foreign Rags

(F. o. b. Boston)

Canvas	(nominal)
Dark Cottons.....	(nominal)
Dutch Blues.....	(nominal)
New Checks and Blues	(nominal)
Old Fustians.....	(nominal)
Old Linsey Garments.	(nominal)
New Silesias.....	(nominal)

CHICAGO

Waste Paper

(F. o. b. Chicago)

Shavings—			
No. 1 White Envelope Cuttings....	3.00	@	—
No. 1 Hard White	2.50	"	2.65
No. 1 Soft White.	2.00	"	2.20
Ledger and Writings	1.30	"	1.45
Solid Books	1.10	"	1.15
Blanks	1.50	"	1.55
Krafts	2.20	@	2.30
New Kraft Cuts....	2.40	"	2.50
Overissue News.....	.75	"	.85
Old Newspapers—			
No. 1 Folded News	.70	"	.75
No. 1 Mixed Paper	.60	"	.65
Roofing Stocks—			
No. 1.....	.95	"	1.00
No. 2.....	.85	"	.90

Water Shortage Less Acute

GLENS FALLS, N. Y., July 21, 1941—Announcement is made here of the resumption of full time operations at the mills of Finch, Pruyn & Co. with prospects of continuing indefinitely. The concern had been handicapped by low water conditions for some time past but heavy rains have relieved this difficulty. An official of the concern stated that he believes that no shutdown will be necessary at present or in the immediate future.

Improved conditions are also noted at the Corinth mill of the International Paper Company where operations were increased to some extent this week as all eight machines used in the manufacture of newsprint were started. Only six of the machines had been running recently because of a shortage of power caused by the drought. Recent rains have improved the situation although the waters in the huge Sacandaga Reservoir are still far below normal.

Cohoes Paper Mill Workers Meet

COHOES, N. Y., July 21, 1941—The annual meeting and election of officers of the local branch of the International Brotherhood of Pulp, Sulphite and Paper Mill Workers was held here last week at which Earl F. Radcliff was re-elected president for a fifth term. Other officers elected include Alfred H. Thompson, vice president; George W. Pelton, recording secretary; Arthur Marland, financial secretary and treasurer, and Earl Drummond, William Morris and John L. Ryan, trustees. At the same time it was announced that the union has negotiated a new working agreement with the Cohoes Envelope Company which calls for union recognition with the International body as sole bargaining agent, general wage increases and a week's vacation with pay.